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MISTY CASTLE Series
MILL RACE Event
Test Execution Report

Test Directorate
Field Command
Defense Nuclear Agency
Kirtland Air Force Base, New Mexico 87115

18 December 1981

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Test Execution Report describes the activities associated with the fielding and execution of MILL RACE. Included in the description are test objectives, requirements and planning, Test Group Staff organization, site evaluation and selection, safety and security requirements, charge configuration and stacking, schedule, instrumentation and administrative parks, timing and firing, experiments, experimenters and support agencies. The Appendices include environmental assessment, charge design and construction, public affairs plan, countdown procedures, countdown hold policy, and lessons learned.

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PREFACE

MILL RACE was a Defense Nuclear Agency (DNA) sponsored high explosive (HE) test designed to provide a simulated one kiloton nuclear weapon airblast and ground motion environment and; for certain preselected experiments, a thermal radiation fluence. Experiments fielded on MILL RACE were sponsored by the Department of Defense (DOD), other government agencies, and two foreign governments.

MILL RACE was conducted 16 September 1981 on the White Sands Missile Range (WSMR), New Mexico (NM). The HE was composed of 600 tons [544 megagrams (Mg)] of ammonium nitrate fuel oil (ANFO). The thermal radiation source (TRS) was generated by a liquid oxygen and aluminum powder mixture.

Table 1. Conversion factors for U.S. customary to metric (SI) units of measurement.

To Convert From	To	Multiply By
angstrom	meters (m)	1.000 000 X E -10
atmosphere (normal)	kilo pascal (kPa)	1.013 25 X E +2
bar	kilo pascal (kPa)	1.000 000 X E +2
barn	meter^2 (m^2)	1.000 000 X E -28
British thermal unit (thermochemical)	joule (J)	1.054 350 X E +3
calorie (thermochemical)	joule (J)	4.184 000
cal (thermochemical)/cm^2	mega joule/m^2 (MJ/m^2)	4.184 000 X E -2
curie	*giga becquerel (GBq)	3.700 000 X E +1
degree (angle)	radian (rad)	1.745 329 X E -2
degree Fahrenheit	degree kelvin (K)	$t_K = (t°F + 459.67)/1.8$
electron volt	joule (J)	1.602 19 X E -19
erg	joule (J)	1.000 000 X E -7
erg/second	watt (W)	1.000 000 X E -7
foot	meter (m)	3.048 000 X E -1
foot-pound-force	joule (J)	1.355 818
gallon (U.S. liquid)	meter^3 (m^3)	3.785 412 X E -3
inch	meter (m)	2.540 000 X E -2
jerk	joule (J)	1.000 000 X E +9
joule/kilogram (J/kg) (radiation dose absorbed)	Gray (Gy)	1.000 000
kilotons	terajoules	4.183
kip (1000 lbf)	newton (N)	4.448 222 X E +3
kip/inch^2 (ksi)	kilo pascal (kPa)	6.894 757 X E +3
ktap	newton-second/m^2 (N-s/m^2)	1.000 000 X E +2
micron	meter (m)	1.000 000 X E -6
mil	meter (m)	2.540 000 X E -5
mile (international)	meter (m)	1.609 344 X E +3
ounce	kilogram (kg)	2.834 952 X E -2
pound-force (lbs avoirdupois)	newton (N)	4.448 222
pound-force inch	newton-meter (N·m)	1.129 848 X E -1
pound-force/inch	newton/meter (N/m)	1.751 268 X E +2
pound-force/foot^2	kilo pascal (kPa)	4.788 026 X E -2
pound-force/inch^2 (psi)	kilo pascal (kPa)	6.894 757
pound-mass (lbm avoirdupois)	kilogram (kg)	4.535 924 X E -1
pound-mass-foot^2 (moment of inertia)	kilogram-meter^2 (kg·m^2)	4.214 011 X E -2
pound-mass/foot^3	kilogram/meter^3 (kg/m^3)	1.601 846 X E +1
rad (radiation dose absorbed)	**Gray (Gy)	1.000 000 X E -2
roentgen	coulomb/kilogram (C/kg)	2.579 760 X E -4
shake	second (s)	1.000 000 X E -8
slug	kilogram (kg)	1.459 390 X E +1
torr (mm Hg, 0° C)	kilo pascal (kPa)	1.333 22 X E -1

*The becquerel (Bq) is the SI unit of radioactivity; 1 Bq = 1 event/s.
**The Gray (Gy) is the SI unit of absorbed radiation.

A more complete listing of conversions may be found in "Metric Practice Guide E 380-74," American Society for Testing and Materials.

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SECTION 1

INTRODUCTION

MILL RACE was a high explosive (HE) test at the White Sands Missile Range (WSMR), New Mexico (NM) sponsored by the Defense Nuclear Agency (DNA). The test provided a simulated nuclear weapon airblast, thermal, and ground motion environment for a number of experiments conducted by the Department of Defense (DOD), other government agencies, and two foreign governments. [redacted] The installation and subsequent checkout and testing of the TRSs was supervised by Science Application, Inc. (SAI) and Test Group Staff (TGS) personnel. Applicable airblast predictions regarding free airblast isobars and extended range airblast pressures made by both the U.S. Army Ballistics Research Laboratory (BRL) and the SNLA were provided for MILL RACE. In addition, ground motion and crater predictions made by the Containment Division, Test Directorate (TD), Field Command (FC) DNA were provided for MILL RACE.

The U.S. Army Engineer Waterways Experiment Station (WES) recorded the ground motion measurements. BRL made airblast measurements at selected testbed and experiment stations. The Bendix Field Engineering Corporation (BFEC), experimenters, or a combination thereof, recorded testbed sensor measurements. The Air Force Weapons Laboratory (AFWL) obtained crater, ejecta, and related effects data through the University of New Mexico (UNM) Civil Engineering Research Facility (CERF). The WSMR obtained detonation diagnostic photography from ground level stations through their photography contractor, Dynalectron Corporation. Documentary and technical photography including both still photographs and motion pictures were also provided by the WSMR contractor. Aerial photography was conducted by Williamson Aircraft Company (WAC).

BFEC provided instrumentation services including a maintenance facility. The Instrumentation Branch, TD, FCDNA provided the timing system trailer. SNLA provided the arming and firing support for the test. The WSMR Up-Range Facilities Engineer (FE) Section provided construction support under direction of the Test Group Engineer (TGE). Engineering services support was provided to the TGE by Ken O'Brien Associates (KOA) who is under contract to HQDNA. Technical documentation was provided by Tech. Reps. Inc. (TRI).

All experiments/measurements on MILL RACE were placed into one of four categories. These categories were: (1) Phenomenology, (2) Structures, (3) Systems, and (4) Dust and Debris. Phenomenology experiments included the ground motion and airblast measurements, test of stress gage design, elevated airblast and airflow measurements, source characterization, and measurements of magnetic field perturbations. Structures experiments included determining the vulnerability and investigating the response of scale model steel, wood, brick, and concrete block buildings, silos, and other types of shelters. Systems experiments included investigating the survivability and vulnerability of various types of ship antennas, van mounted shelters, trailer disk antennas, tank and cavalry fighting systems; determining airblast effects on simulated crews in vehicles and shelters and in the open, clothed in protective clothing; and determining the hardness of a Seawolf launcher, communications box body, and Ptarmigan masts. Dust and debris experiments were essentially measurements of dust density and particle size, and of the attenuation/degradation of optical systems due to dust/cloud formation. Experiments defining the impact, breakup, and redistribution of debris were also included in this fourth category. The objective and a description of each experiment are in Section 4 "Experiments." Appendix A is a list of acronyms and abbreviations used in this report.

SECTION 2

TEST REQUIREMENTS, PLANNING, AND ORGANIZATION

2-1 TEST REQUIREMENTS.

The requirements for MILL RACE originated from the need to provide a simulated nuclear airblast and ground motion environment, as well as a thermal radiation fluence for selected experiments. Ideally, experiments would be exposed to the effects of actual nuclear weapons, but the 1963 Nuclear Test Ban Treaty prohibits atmospheric nuclear tests. In addition, the cost of conducting large-scale nuclear airblast experiments underground is prohibitive. Since 1962, airblast data have been obtained by using HE to simulate the airblast environment of nuclear weapons. Data obtained from MILL RACE will be compared with previously reported nuclear effects data and will serve to validate the predictions of a variety of nuclear effects computer codes, thus expanding the knowledge of nuclear weapons effects.

The primary objective of MILL RACE was to provide and record an airblast and ground motion environment designed to determine the response of various DOD-sponsored experiments, including tactical and strategic weapons systems, communication equipment, aircraft vehicles, radar and antenna systems, and a variety of structures. The secondary objective was to provide, for selected experiments, a thermal fluence in addition to the airblast and ground motion environment.

Supporting objectives were to:

a. Record damage to the DOD sponsored experiments

b. Record combined thermal/airblast effects and

c. Increase the nuclear weapons effects data base.

2-2 TEST PLANNING.

DNA announced in February 1980, that MILL RACE, the first event in the MISTY CASTLE series, was to be conducted in September 1981; and requested experiment proposals from interested agencies, both domestic and foreign. A review of the proposed experiments at DNA in May 1980, eliminated inappropriate and duplicating experiments, and established the complex experiment matrix. Responsibility for subsequent planning and executing MILL RACE was assigned to FCDNA. Planning was accomplished primarily through two project officer meetings (POMs) conducted in September and December 1980 in Albuquerque, NM. The testbed layout and all experiment requirements were discussed, coordinated, and finalized.

The test site for MILL RACE at WSMR was chosen because preliminary geology efforts and previous HE tests at WSMR had indicated that the area best met the required geologic criteria for ground motion experiments. To obtain approval for use of WSMR for MILL RACE, the WSMR Program Introduction (PI) document was prepared and submitted to WSMR. The PI is the initial document in the Universal Documentation System (UDS) which requires all users of National Ranges to submit approval requests. The PI was completed by FCDNA personnel and submitted 16 July 1980. WSMR signed and accepted the PI in late July 1980. The Statement of Capability, which provided WSMR approval for use of the proposed site for MILL RACE, established FCDNA responsibilities, and provided for use of WSMR support facilities by FCDNA; was signed on 10 October 1980. WSMR test coordination for MILL RACE was assigned to the National Range Programs (NRP) Directorate. Additional MILL RACE information was provided by the Test Group Director (TGD) to the WSMR Planning Board. That information (Operations Requirement 96301, Appendix B-1), which provided more detailed support requirements, resulted in Operations Directive 96301A (Appendix B-2) being issued in August 1981. Operation Directive 96301A provided the formal tasking of WSMR directorates to support MILL RACE. Additionally Operation Directives 96304A, 96308A, and 97916A (Appendices B-3, B-4, and B-5, respectively) were prepared for drone and other aircraft experiments participating in MILL RACE. These experiments are discussed in Sections 4-1.8, 4-1.9, and 4-1.13.

Following the assignment of a MILL RACE Test Group Staff (TGS), the staff proceeded to select agencies to provide technical support associated with MILL RACE. BRL was selected to make the airblast measurements and WES to make the measurements for ground motion. SNLA was selected to provide the arming and firing system and make far field microbarograph measurements. WSMR provided significant logistics support and all testbed and some experiment construction support. WSMR, through Dynalectron Corporation, also performed the diagnostic and technical photography as well as providing the documentary coverage. NSWC provided the main booster assembly and quality control of ANFO stacking operations. CERF was assigned through AFWL to make measurements of cratering, debris, and ejecta.

Safety and security requirements were developed with WSMR personnel. Appropriate Department of Army, WSMR, and FCDNA safety regulations were used during the fielding of MILL RACE. Safety Standard Operating Procedures (SOPs) were prepared for all hazardous operations. MILL RACE implementing instructions were issued as required. Copies of applicable safety rules, SOPs, and implementing instructions are contained in Appendix C. The security plans applicable to MILL RACE are contained in Appendix D.

Although there is a WSMR Environmental Impact Assessment for National Range Operations, the Assessment does not cover large HE tests. DNA therefore contracted with General Electric-TEMPO, now Kaman-TEMPO, to have an Environmental Assessment (EA) prepared for MILL RACE. The EA was prepared and published in November 1980 as GE80TMP-49 "Environmental Assessment of the MILL RACE High-Explosive Field Test" (Appendix E-1). In preparing the MILL RACE EA, special consideration had to be given to the impact of the MILL RACE test on McDonald Ranch and any archaeological sites in the test operating areas.

McDonald Ranch as part of the Trinity National Historical Site, was in a very deteriorated condition, and was only 12,000 feet (3,658 meters) north of MILL RACE ground zero (GZ). Trinity, the world's first nuclear test device, was assembled at McDonald Ranch. The ranchhouse still has a roof but other structures, including a barn and living quarters, are just standing walls without roofs. All are most susceptible to airblast overpressures and ground motion. Because of the relative close proximity of McDonald Ranch to GZ, DNA contracted with General Electric-TEMPO to perform a structural analysis of the ranch. The analysis was prepared and published as GE80TMP-53 "MILL RACE Assessment of Structures at the McDonald Ranch" (Appendix E-2). It was concluded that there is "a high probability that no substantial damage will occur to any structure due to the MILL RACE test."

To determine that no archaeological sites would be damaged by MILL RACE activities, WSMR contracted for DNA to have personnel from New Mexico State University conduct an archaeological survey of the area within a radius of 12,000 feet from GZ. No significant archaeological sites were found within the MILL RACE area.

Based upon the assessment, the structural analysis of McDonald Ranch, and the archaeological survey of the MILL RACE test site, the EA concluded that MILL RACE is not likely to result in significant environmental impacts or be environmentally controversial. A further conclusion was that an Environmental Impact Statement was not required. DNA also determined that an Environmental Impact Statement was not necessary (Appendix E-4) and signed a Finding of No Significant Impact (Appendices E-5 and E-6).

A Public Affairs Plan (Appendix F) was prepared by WSMR which described policies, objectives, and responsibilities, and provided guidance for the conduct of public activities in connection with the MILL RACE test.

2-3 SITE SELECTION.

Evaluation of site alternatives for MILL RACE included consideration of depth to water table, availability of soil property information, and immediate accessibility for a testing location including the availability of a testbed site. The general area south of TRINITY and DICE THROW was selected for detailed investigation because the geology and material properties of the area had been developed for DICE THROW, and because it was known that the geological formations in that area were laterally consistent and uniform. There were only limited constraints for airblast overpressures, specifically time of day for shot. Also, WSMR provided an immediately available area for conducting a HE test.

Specific criteria for site selection were as follows:

a. Medium-grain dry desert alluvium similar to the alluvium in Area 10 of the Nevada Test Site (NTS) where JANGLE S and SEDAN were detonated.
b. Minimum caliche and boulder zones to 135 feet (41.1 meters) within crater zone and ground shock sector.

c. A water table and bedrock at least 102 feet (31.1 meters) below the surface.

d. A surface gradient of no more than 5 percent.

e. Reasonably uniform stratigraphy and topography over site.

[redacted]

Eight seismic refraction surveys were made in the area south of the TRINITY and DICE THROW test sites in the northern region of WSMR. The purpose for these surveys was to establish the depth to the water table and/or bedrock, and to obtain subsurface seismic velocities at several potential MILL RACE test sites. The area that was being considered for MILL RACE is shown in Figure 2-1. After a specific GZ was selected (Figure 2-2), a borehole was drilled to verify the computed depth to the water table. The water table was logged at 246 feet (75 meters). The borehole logs show the soil profile above the water table to be relatively uniform and mainly composed of medium to coarse grained sand (Figure 2-3). Appendix G-1 contains a copy of the complete results of the seismic surveys and a summary of the borehole drilling. More detailed results of the borehole drilling are found in Appendix G-2.

2-4 TEST GROUP STAFF ORGANIZATION.

The organization of the MILL RACE TGS is shown in Figure 2-4. Test Group Staff duties were as follows:

2-4.1 Test Group Director.

a. Responsible for formulation of the MILL RACE test program:

(1) Manage the planning of the test to include budgeting, scheduling, and defining all aspects of the test program.

(2) Assist the Technical Director in preparing the scientific experiment plan.

(3) Supervise the preparation of operational plans for the fielding and execution phases of the test program.

(4) Prepare and publish the Program Document.

b. Responsible for fielding and execution of the MILL RACE program:

(1) Direct the fielding aspects of the program onsite to include scheduling, budgeting, construction, and emplacement of experiments and recording systems.

(2) Formulate and direct the safety and security plans for the test series and appoint a Safety and Security Officer.

(3) Plan, control, and report the expenditure of funds.

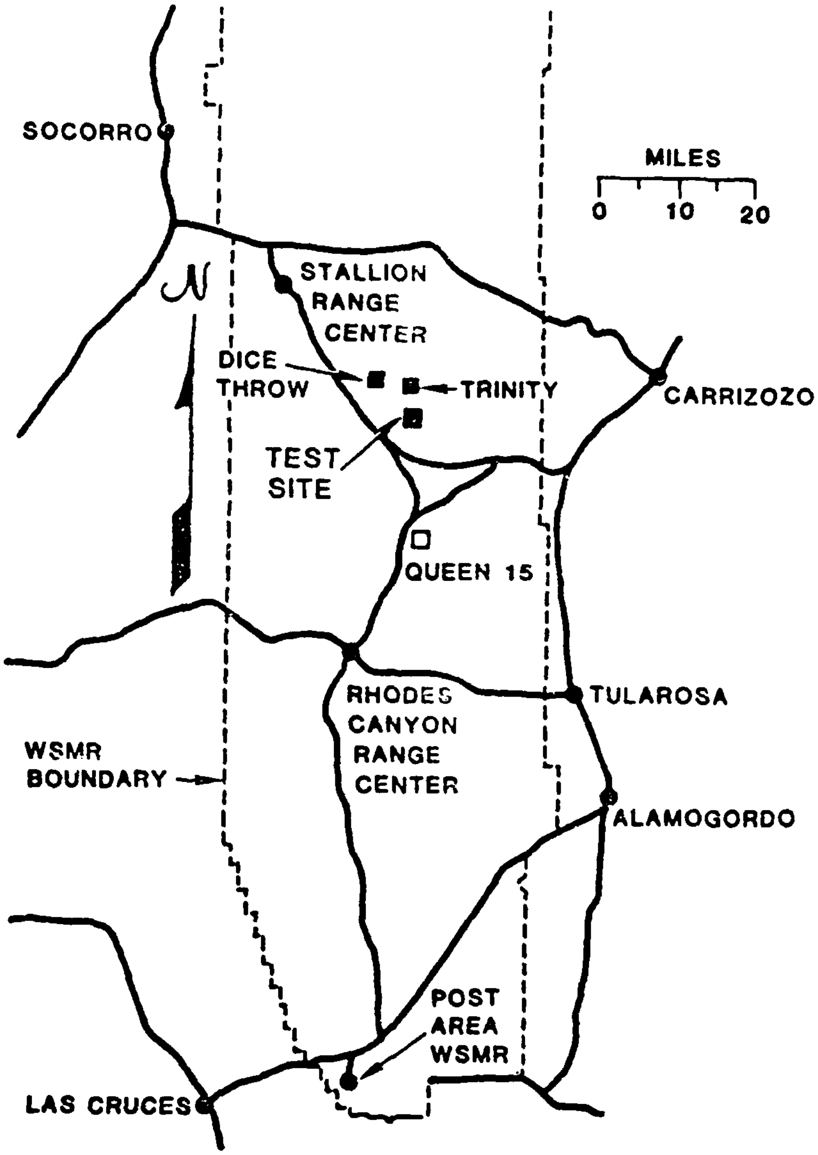


Figure 2-1. WSMR test site location.

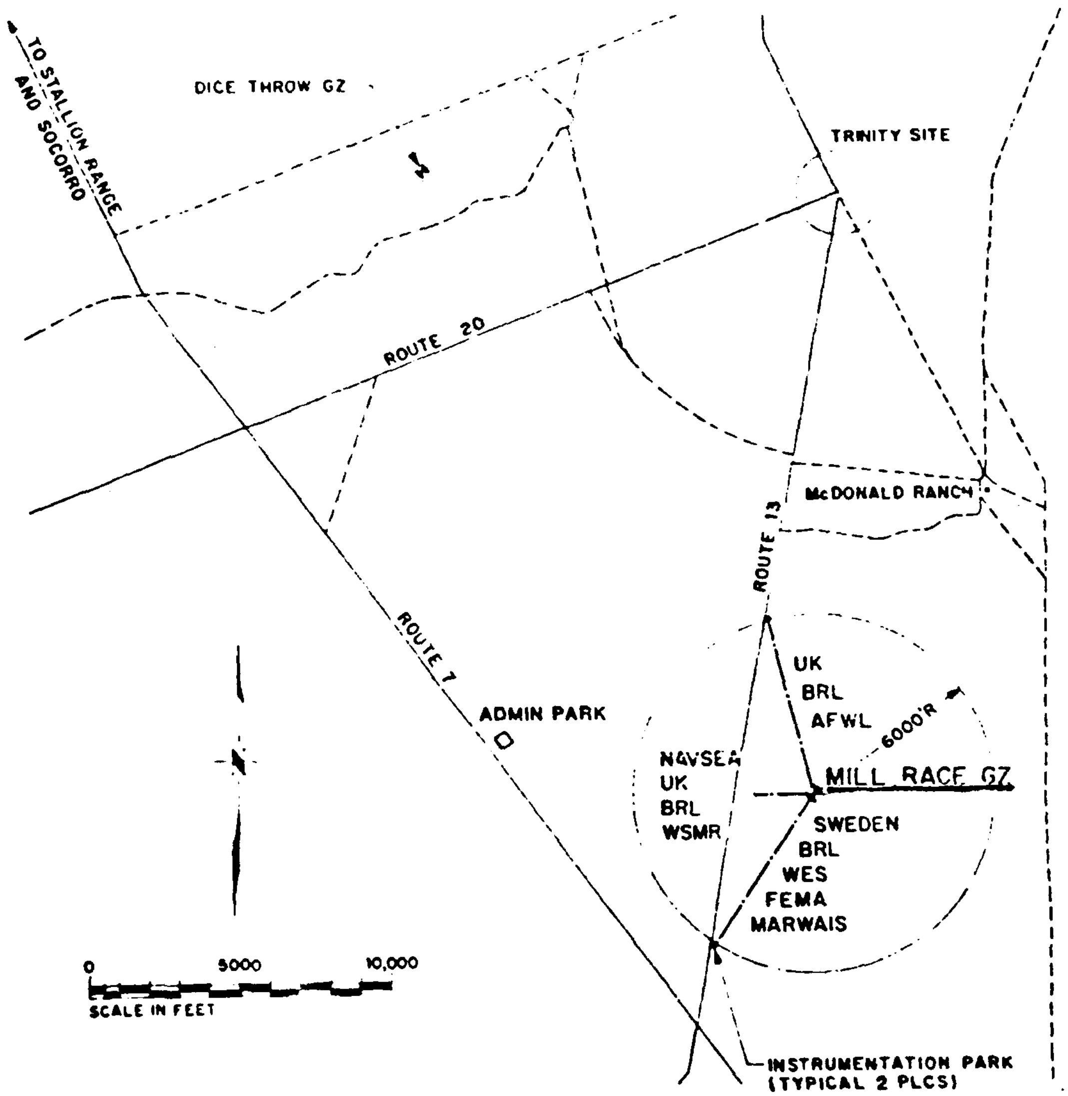


Figure 2-2. Ground zero location.

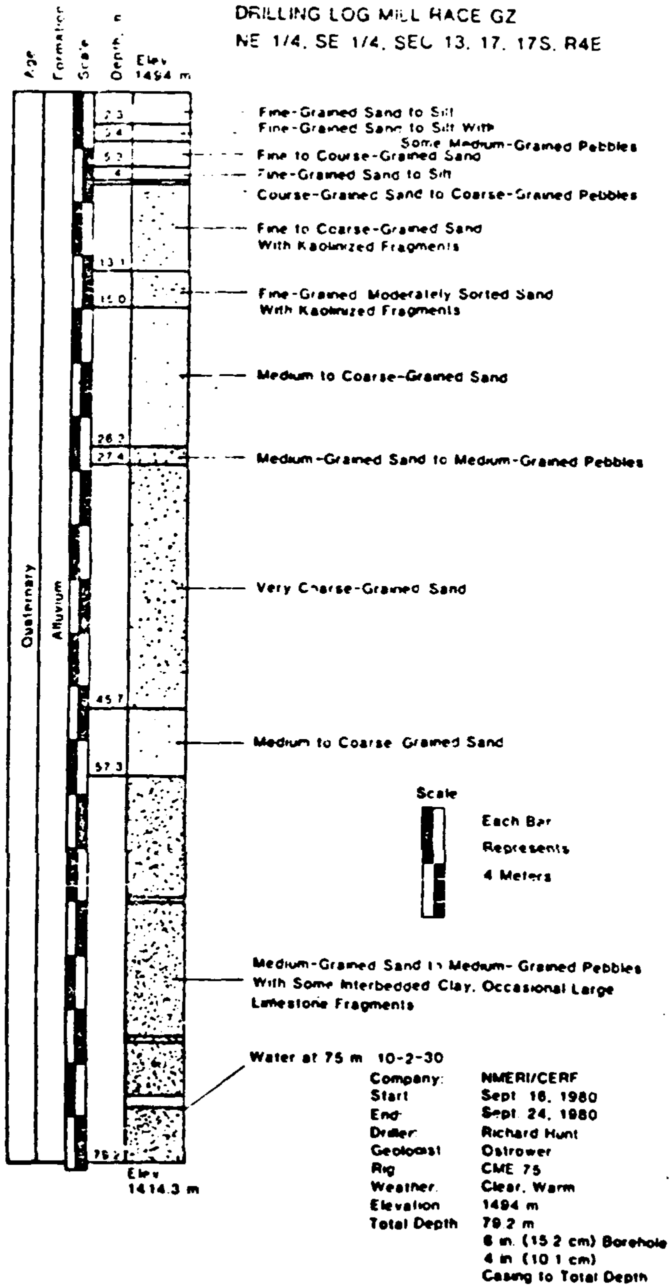


Figure 2-3. Drilling log for MILL RACE GZ.

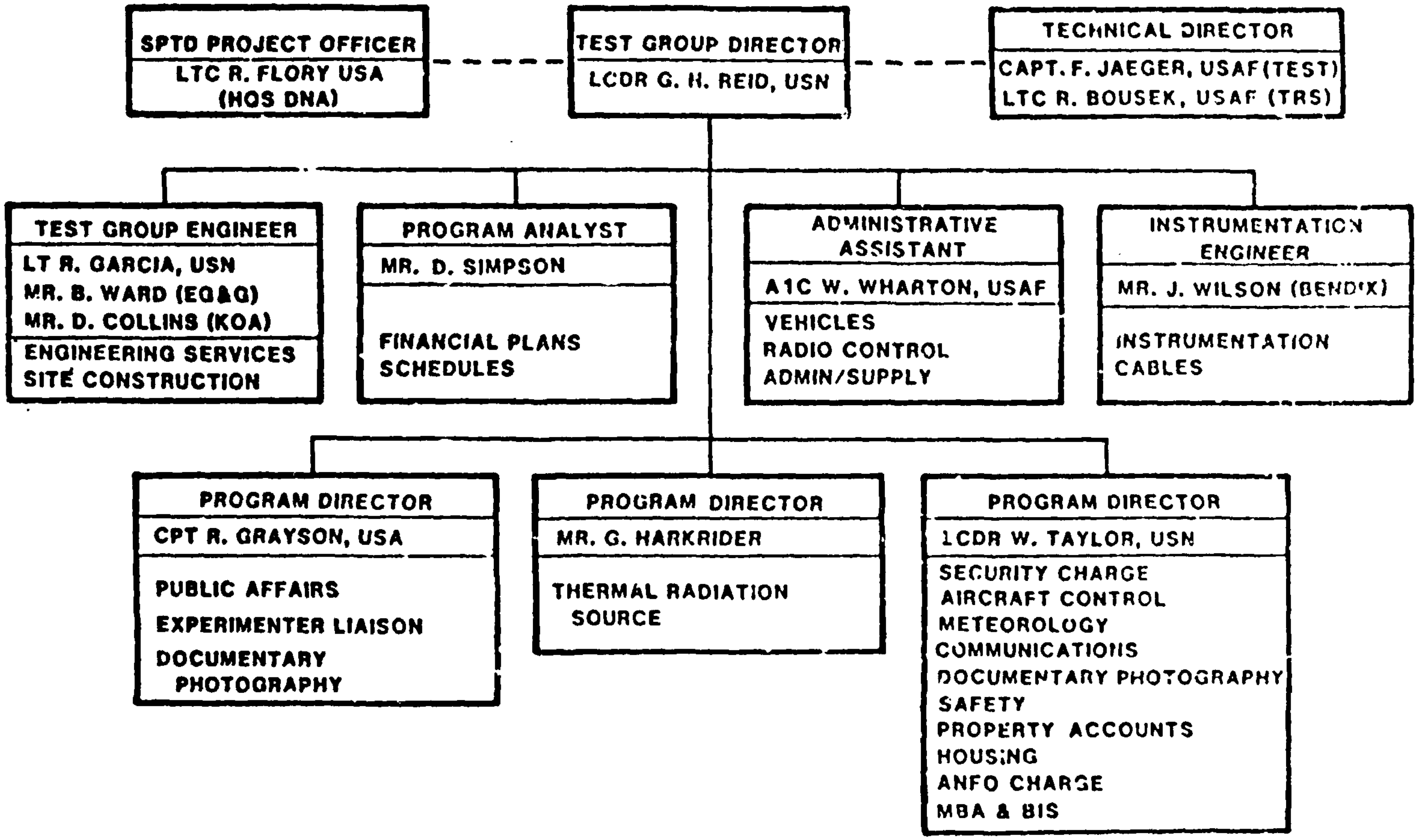


Figure 2-4. MILL RACE organization.

(4) Establish requirements for and control logistic support.

(5) Coordinate details of the HE placement, arming and firing, and site control with the agencies responsible for these technical functions.

(6) Prepare and publish the Test Execution Report.

2-4.2 Technical Director.

a. Responsible for formulation of the MILL RACE technical program:

(1) In coordination with experimenter agencies and the Test Group Director (TGD), modify as necessary the technical experiments using current best practices in order to obtain the quality of data required to achieve the objectives of Deputy Director Science and Technology (DDST) approved goals.

(2) Prepare a detailed technical plan to accomplish the scientific program and assist the TGD in preparing a schedule to assure timely execution of the test.

(3) Assist the TGD in preparing the Program Document.

(4) Evaluate the effect of safety restrictions on the achievement of the scientific objective(s).

b. Responsible for fielding and execution of the MILL RACE technical program:

(1) Serve as an advisor on the TGS and support the TGD during fielding.

(2) Supervise and coordinate the technical activities of the test and advise the TGD concerning management of the technical activities of the experiments in the field.

(3) Monitor the state-of-readiness of the technical experiments, manage installation of experiments in conjunction with the TGS, and make recommendations for adjusting the schedule as necessary.

(4) Coordinate impact on technical activities concerning funds, schedules, test support, field operations, and relationships with other agencies with the TGD and other staff members. Coordinate with the DDST and cognizant HQ DNA Project Officers.

(5) Formulate changes in the technical plan as necessary to achieve the scientific objectives and approve minor adjustments in the scope of the technical experiments. Coordinate major changes or adjustments of funding levels with the TGD and the cognizant HQ DNA Project Officers prior to submittal to DDST for approval.

(6) Monitor the construction and instrumentation of all experiments, ensuring that all experimenter modifications conform to current best practice.

(7) Review Symposium and Project Officers' Reports.

(8) Prepare and publish the Symposium Project Officer Report.

2-4.3 Program Directors.

a. Assist the TGD as required in planning and executing the MILL RACE test program.

b. Assist in developing the testbed design and determining construction requirements.

c. Develop operational, engineering, technical, and administrative plans, as directed.

d. Coordinate and monitor the activities of experimenters/agencies during the planning, fielding, executing, and recovery of the test.

2-4.4 Test Group Engineer.

a. Provide engineering support in the planning, fielding, executing, and recovery of the MILL RACE test.

b. Assist in the test site and testbed design to include instrumentation and administration parks, and determine construction requirements and schedules for all aspects of the test.

c. Perform engineering design and construction management associated with test site and testbed preparation, experiment installation, and site recovery.

d. Coordinate the logistical support effort associated with the test.

2-4.5 Instrumentation Engineer (IE).

a. Perform instrumentation and cable planning, and instrumentation park management for the MILL RACE test program.

b. Coordinate requirements and oversee instrumentation support during the planning, fielding, and execution phases of the test. This will include determining experimenter requirements, configuring instrumentation vans, designing cable layouts, performing cable coordination functions, providing for instrumentation maintenance, and laying out the instrumentation park.

2-4.6 Program Analyst (PA).

a. Develop and maintain the MILL RACE test schedule.

b. Prepare progress/status reports as required.

c. Provide financial management of the MILL RACE test, including preparation of basic testbed and reimbursable cost estimates, maintenance of budget and financial plans, and of all cost accounting.

2-4.7 Administrative NCO.

a. Perform all administrative duties required to support the MILL RACE Test Group Staff, support agencies, and experimenters.

b. Perform as a Project Net Operator in Test Control during event countdown and execution.

c. Perform as the Test Group Staff Vehicle Control Officer and assist in staff billeting.

2-5 PLANNING SCHEDULE.

Figure 2-5 is the Planning Schedule for MILL RACE. Prior to the events shown the Schedule, other major events had occurred.

a. During the period from early January 1980 to near the end of August 1980, t test range, the testbed area, and GZ were selected (see Section 2-3 "Site Selection" and Appendix G).

b. During the period from 8 February 1980 through mid-December 1980, potential experimenters proposed experiments, a proposal review meeting was held, experiments were selected, and two project officer meetings were held (see Section 2-2 "Test Planning").

c. From mid-July 1980 to the end of September 1980, the FCDNA-funded support agencies were selected and negotiations initiated with the selected agencies to provide the required support.

d. Between September 1980 and January 1981, experiment cost estimates were issued and reimbursable funding amounts were established.

e. Between the two project officer meetings held in September and December 1980 a tentative but complete testbed layout was made. Following the second meeting, the final testbed layout was prepared and, except for late-time add-on experiments, it was the one used to position the experiments.

f. From mid-November 1980 through the second project officer meeting and to mid-January 1981 the final cable and instrumentation plan was prepared. The plan was used to obtain the cable and instrumentation for MILL RACE.

Other phases of the Planning Schedule include:

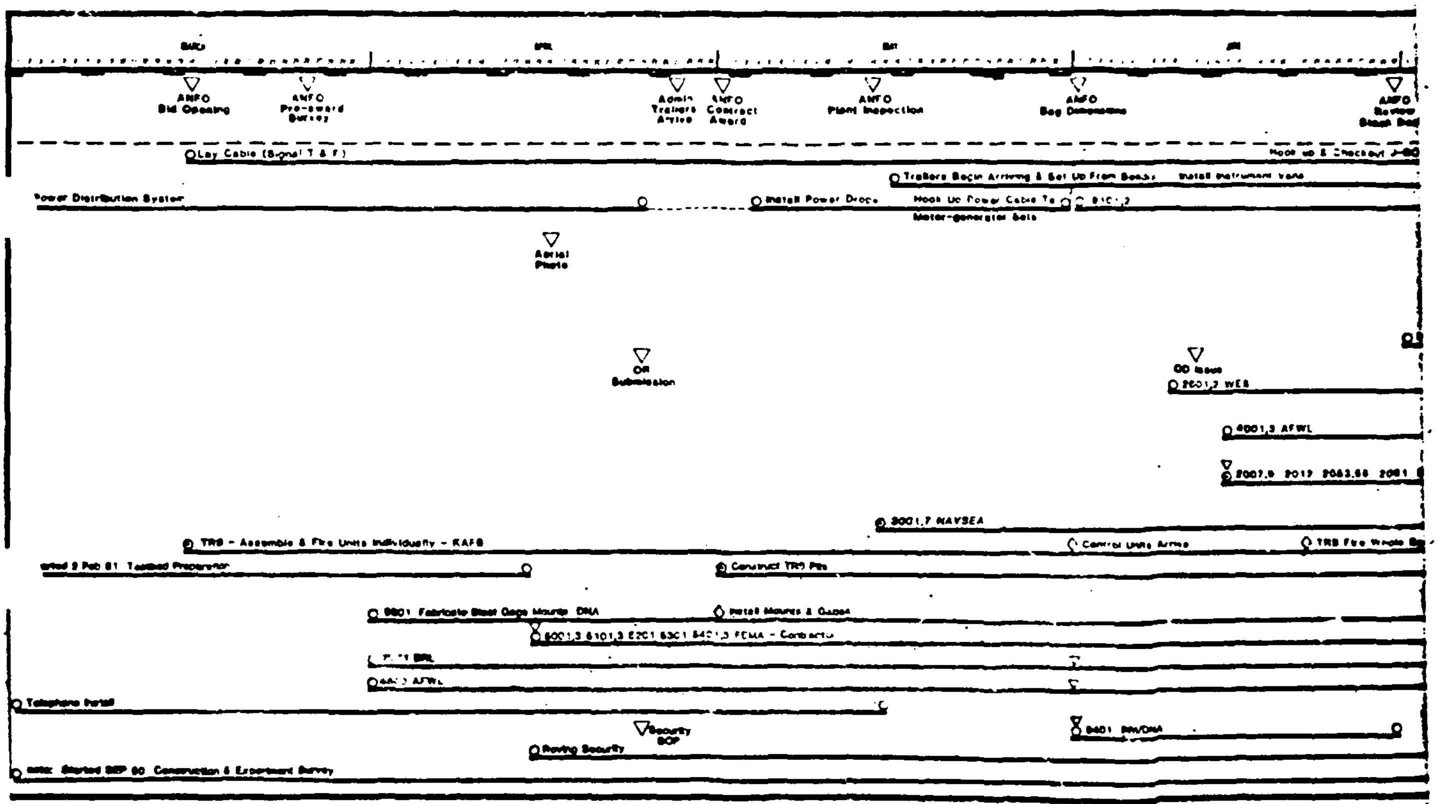
a. Procurement of the ANFO including issuing a competitive procurement contract as well as stacking the individual 50-pound bags of ANFO. Delivery of the ANFO bags was done by the contractor and stacking was done by WSMR Facility Engineer (see Section 3-1).

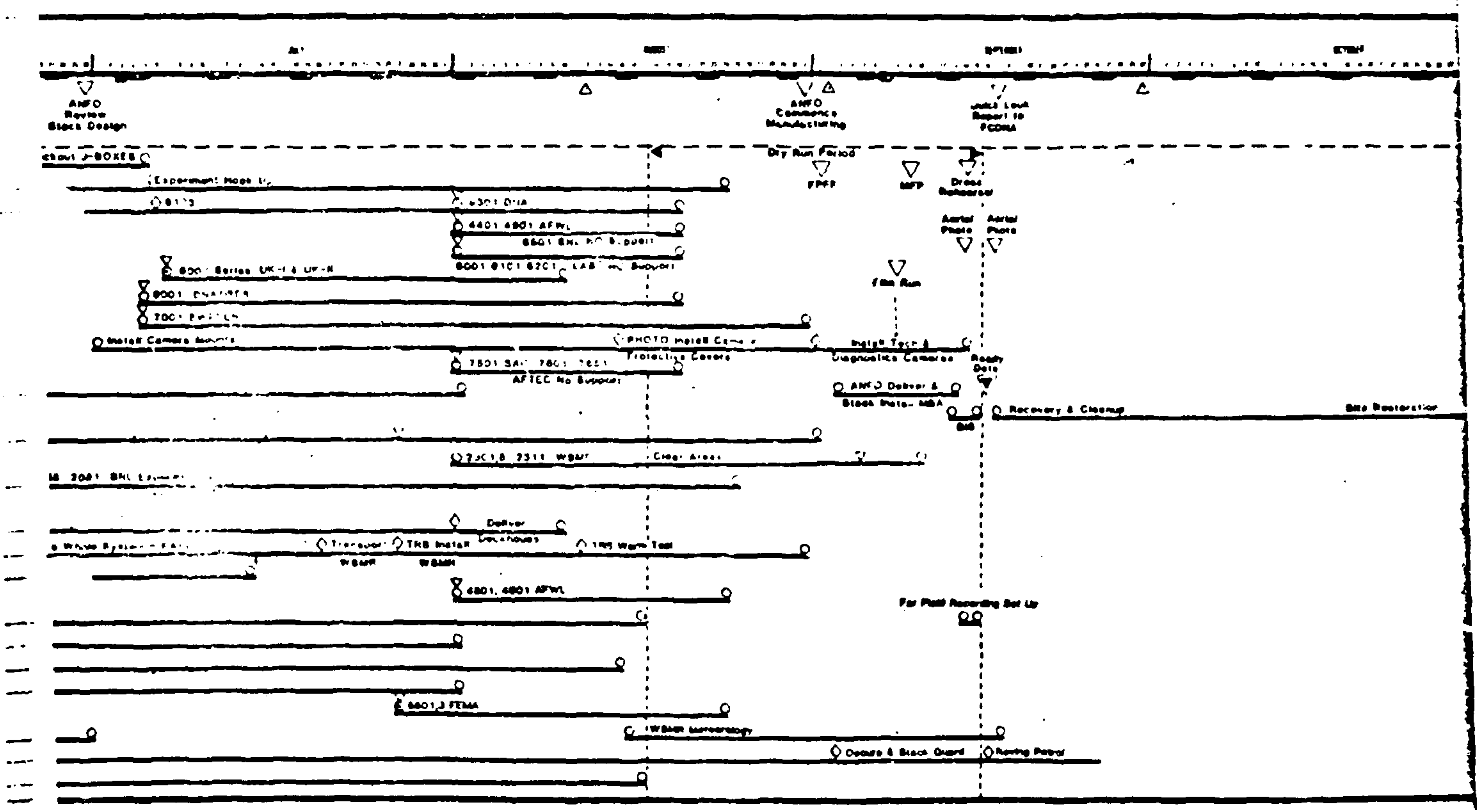
b. Activities associated with the TRS to include assembly and test of the TRS units at Kirtland AFB, NM, and delivery, assembly, and testing at WSMR. Section 3-2.3 also provides additional information on the TRS.

c. Fielding activities that are discussed in Section 5.

2-6 BUDGET.

DNA budgeted and funded the cost of constructing and operating the basic testbed, which included (1) the timing and firing system, the ANFO explosive, the free field airblast and ground motion measurements and (2) the two instrumentation parks, administrative area park, and various logistic and administrative services. The cost of other common


ANFO Bid Opening
ANFO Pre-award Survey
Admin Trailers Arrive
ANFO Contract Award
ANFO Plant Inspection
ANFO Bag Dimensions
Lay Cable (Signal T & F)
Hook up & Checkout
Trailers Begin Arriving & Set Up From Boxes
Install Instrument Vans
Power Distribution System
Install Power Drops
Hook Up Power Cable To Motor-generator Sets
Aerial Photo
OR Submission
OO Issue
2001,2 WES
4001,3 AFWL
2007,9 2012 2063,68 2081
3001,7 NAVSEA
TRS - Assemble & Fire Units Individually - KAFB
Control Units Arrive
Testbed Preparation
Construct TRS Pits
Fabricate Blast Gage Mounts DNA
Install Mounts & Gages
6001,3 6101,3 6201 6301 6401,3 FEMA - Contractor
BRL
AFWL
Telephone Install
Security BOP
Roving Security
Construction & Experiment Survey



ANFO Review Stack Design
ANFO Commence Manufacturing
Dry Run Period
FPFF
MFP
Dress Rehearsal
Aerial Photo
Aerial Photo
Experiment Hook Up
4401 4801 AFWL
Film Run
Install Camera Mounts
PHOTO Install Camera
Protective Covers
Install Tech & Diagnostics Cameras
Ready Date
AFTEC No Support
ANFO Deliver & Stack Petals MBA
Recovery & Cleanup
Site Restoration
Clear Areas
Deliver
TRB Install
WSMR
4801, 4801 AFWL
Far Field Recording Set Up
6801.3 FEMA
WSMR Meteorology
Roving Patrol

F1

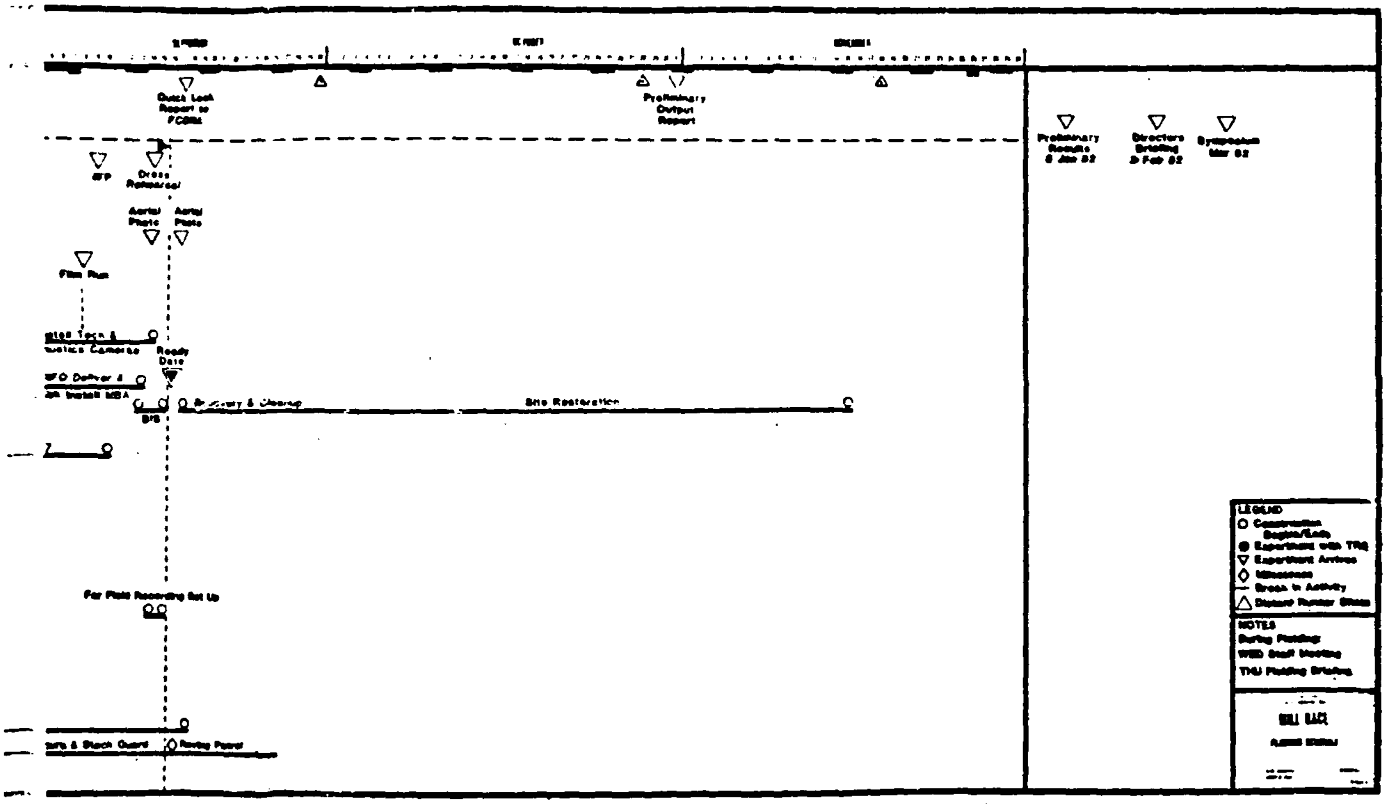


Figure 2-5. Planning schedule.

services such as power and telephone service was prorated among the participating experimenters and paid with reimbursable funds received from the experimenters. Reimbursable funds were used to cover the cost of experimenter requirements not included in the basic testbed. These requirements normally included field construction support, data recording (cables and recording systems) and photographic coverage.

2-7 HIGH EXPLOSIVE TEST PROGRAM.

MILL RACE was the first HE test in the test series known as MISTY CASTLE. Future tests in the MISTY CASTLE series include DIRECT COURSE and MINOR SCALE. Previous HE tests included MIXED COMPANY, DICE THROW, and MISERS BLUFF. The purpose of all these tests is to provide a testbed for a simulated nuclear blast and ground motion environment for target-response experiments; and to confirm empirical predictions and theoretical calculations for blast response of civilian structures, and of military structures, equipment, and weapon systems. In addition, MISERS BLUFF and MILL RACE provided a thermal environment for some of the experiments. The MISERS BLUFF thermal environment was provided by the use of nonreusable plastic cylinders containing oxygen and aluminum powder. The thermal environment at MILL RACE was provided by a more sophisticated, reusable system composed of fuel supplies stored in metal tanks which were manifolded to nozzles. This system will be used extensively in the MISTY CASTLE series.

SECTION 3

TECHNICAL SUPPORT

3-1 ANFO CHARGE (CHARACTERISTICS, DESIGN, AND CONSTRUCTION).

[redacted]

The ANFO was procured by a competitive bid from the joint venture of Woodward Explosive, Inc., Estancia, NM and Ladshaw Explosive, Inc., Hobbs, NM. The ANFO quality-control specifications were modified slightly from PRE-DICE THROW, DICE THROW, and MISERS BLUFF. Modifications included a simpler sieve size distribution and an increase in the allowable ammonium nitrate bulk density. The density increase was allowed in that the industry has gone to a single grade (industrial) of prill instead of the explosive and industrial grades available in the past. The specification included the allowable fuel oil content and constraints on the ammonium nitrate prill size and on the bulk density. Those specifications were as shown in Table 3-1.

The quality of delivered ANFO was ensured through a series of actions. First a pre-award survey was made by the Defense Contract Administrative Services to verify that technical qualifications could be met by the contractors. Second, and prior to the start of manufacture, samples of all materials were obtained. Thirdly, and during stacking operations, a fuel oil and bag weight sampling program was conducted on each delivered load. Quality checks of the off-loaded ANFO were performed at the MILL RACE GZ by personnel from the NSWC. Bag weight checks were made on at least every tenth bag as it was off-loaded. Four samples from each layer, taken from loose ANFO used to fill voids, were analyzed for both fuel oil content and prill size distribution. The quality checks indicated that the composition of the ANFO was very uniform and within the contract specifications.

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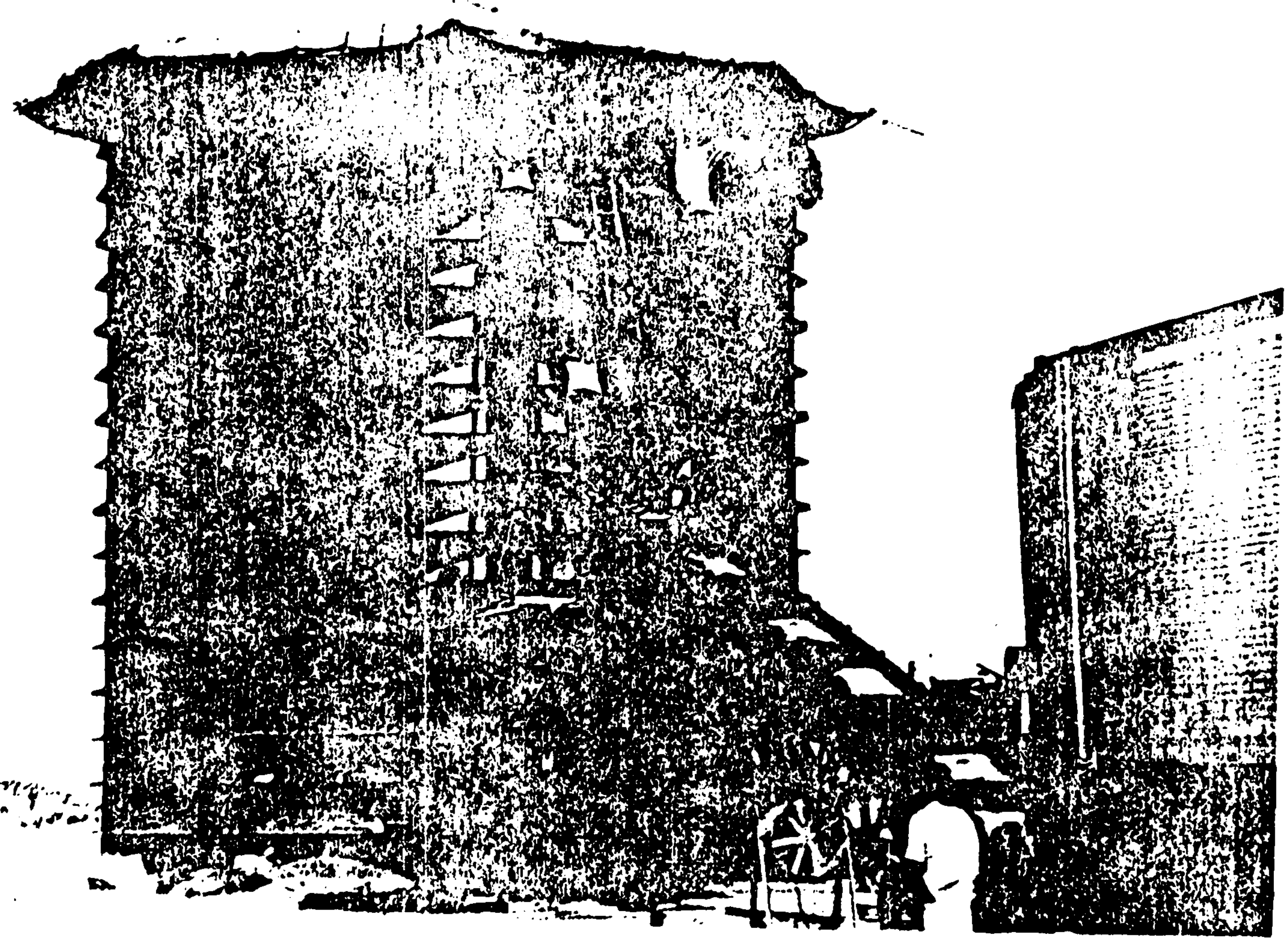

Figure 3-1. Wooden form and tantum conveyor for stacking AFNO.

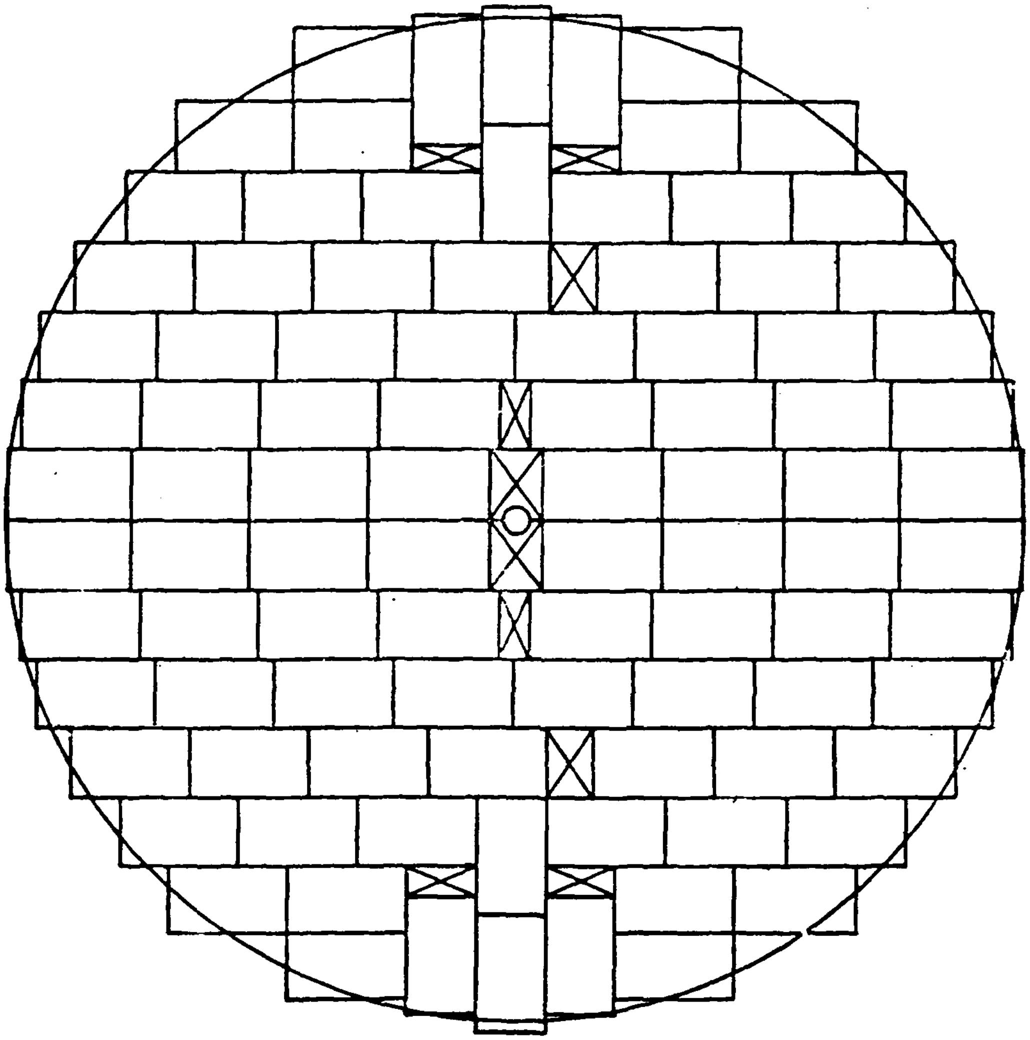

Figure 3-2. MILL RACE ANFO layer cylinder section.

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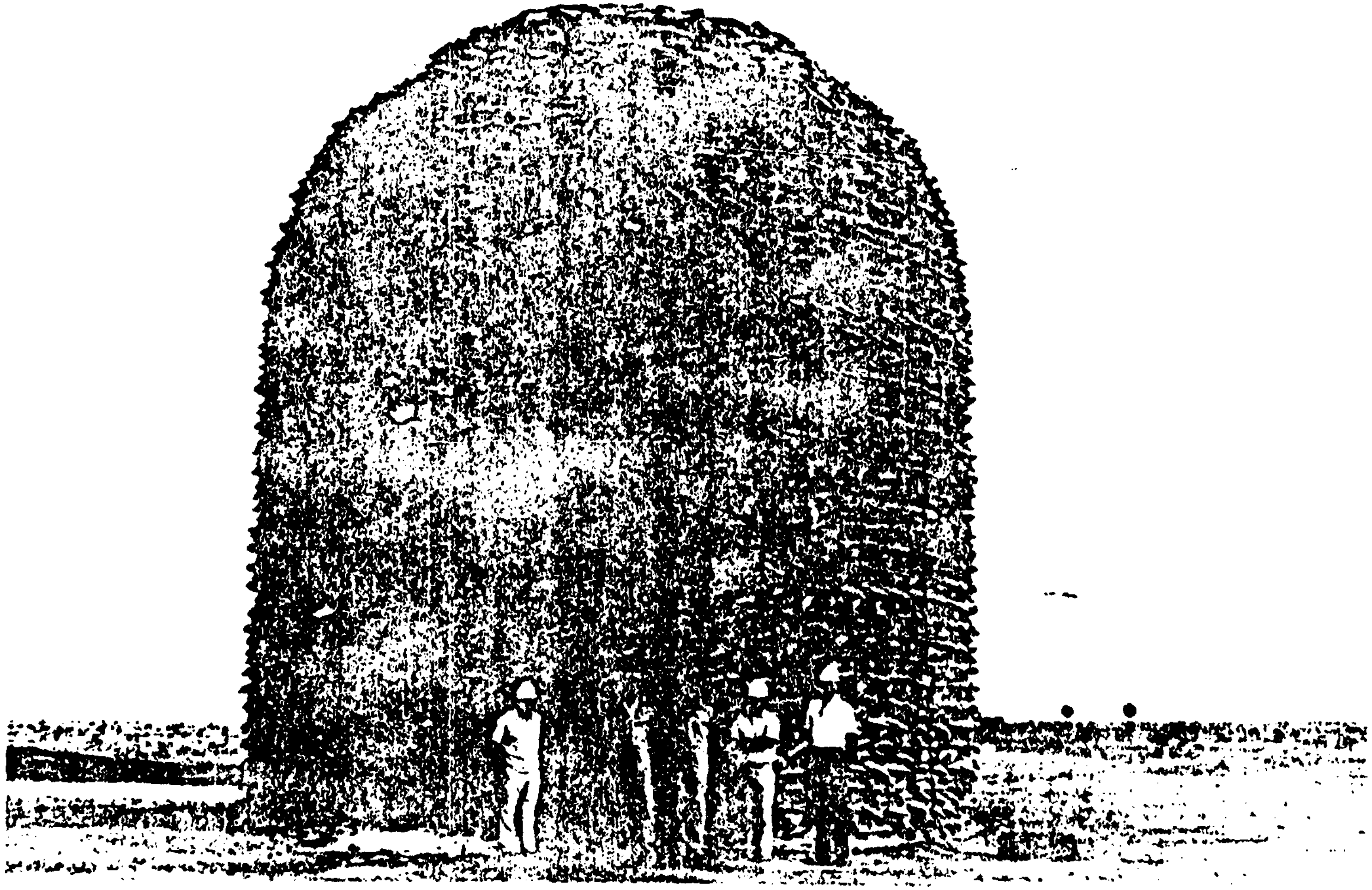

Figure 3-4. MILL RACE stacked charge.

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the control unit of the arming and firing system. All timing signals emanate from the T&F trailer. The signals were used to switch on power supplies, start tape recorders, actuate motion picture cameras, initiate the TRS sequence, and charge and subsequently discharge the X-unit of the arming and firing system.

For MILL RACE, the T&F trailer and its associated equipment were assembled by BFEC from DNA assets stored at NTS. The trailer was then made operational by BFEC and FCDNA personnel at Kirtland Air Force Base (AFB), NM and moved to the test site in May 1981. The assembly of the timing system and its interconnection with the arming and firing system was completed during the week of 10 August 1981. Dry runs with T&F signals sent started on 17 August 1981 and continued through 15 September 1981. A full-power, full-frequency dry run was conducted 1 September 1981. Mandatory full-power (MFP) runs were conducted on (1) 9 September without the participation of the two drones, (2) on 11 September for the drones only, (3) on 14 September and, (4) on 15 September in an abbreviated version to check out the T&F trailer.

Table 3-2 is a list of the timing signals used on MILL RACE. Figure 3-9 is the T&F cable plan.

3-5 THERMAL RADIATION SOURCE CHARACTERISTICS

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mately the 7.5 psi (51.7 kPa) level for experiments fielded by the U.S. Navy, BRL, and the United Kingdom (UK) Army. Each pit contained a four-nozzle system, however, nozzle spacing was different in each case. At the 3.5 psi (24.1 kPa) level, there was one pit with an eight-nozzle system which provided thermal energy for experiments fielded by the UK Navy. Plan drawings of TRS experiment layouts (shown in Figures 3-27, 3-43, 3-50, 3-51, 3-52, 3-53, and 3-58) are included in the series of camera coverage drawings described in Section 3-11, Technical Photography. Table 3-3 provides the burn characteristics of the four TRS

Table 3-2. MILL RACE timing signals.

T-10 min	- Turn on power to UK experiments
T-2 min 45 s	- Start tapes
T-2 min	- Start tapes (backup)
T-1 min	- Start charge of X-unit
T-59 s	- Start BRL calibration sequence
T-58 s	- Start BRL calibration sequence
T-57 s	- Drop T-58s relay
T-56 s	- Drop T-59s relay
T-30 s	- Start WES ground motion and TRS sequence
T-29 s	- Start BRL and AFWL calibration sequence (backup)
T-28 s	- Start BRL calibration sequence (backup)
T-27 s	- Drop T-28s relay
T-26 s	- Drop T-29s relay
T-10 s	- Start technical and diagnostic cameras
T-7 s	- Start technical and diagnostic cameras
T-6 s	- Start technical and diagnostic cameras and T&F recorder
T-5 s	- Start technical and diagnostic cameras
T-4 s	- Start technical and diagnostic cameras
T-3 s	- Start technical and diagnostic cameras
T-2 s	- Start technical and diagnostic cameras
T-2.5 s	- Start technical and diagnostic cameras
T-1 s	- Start technical and diagnostic cameras and turn off SSS charge current
T-0.7 s	- Start technical and diagnostic cameras
T-0.1 s	- Start technical and diagnostic cameras
T-0.0 s	- Fire X-unit and provide WES structures, DNA/SAI, and UK with zero time references
T+1 s	- Drop high voltage to X-unit
T+30 s	- Stop WES ground motion tape recorders
T+2 min	- Drop all signals

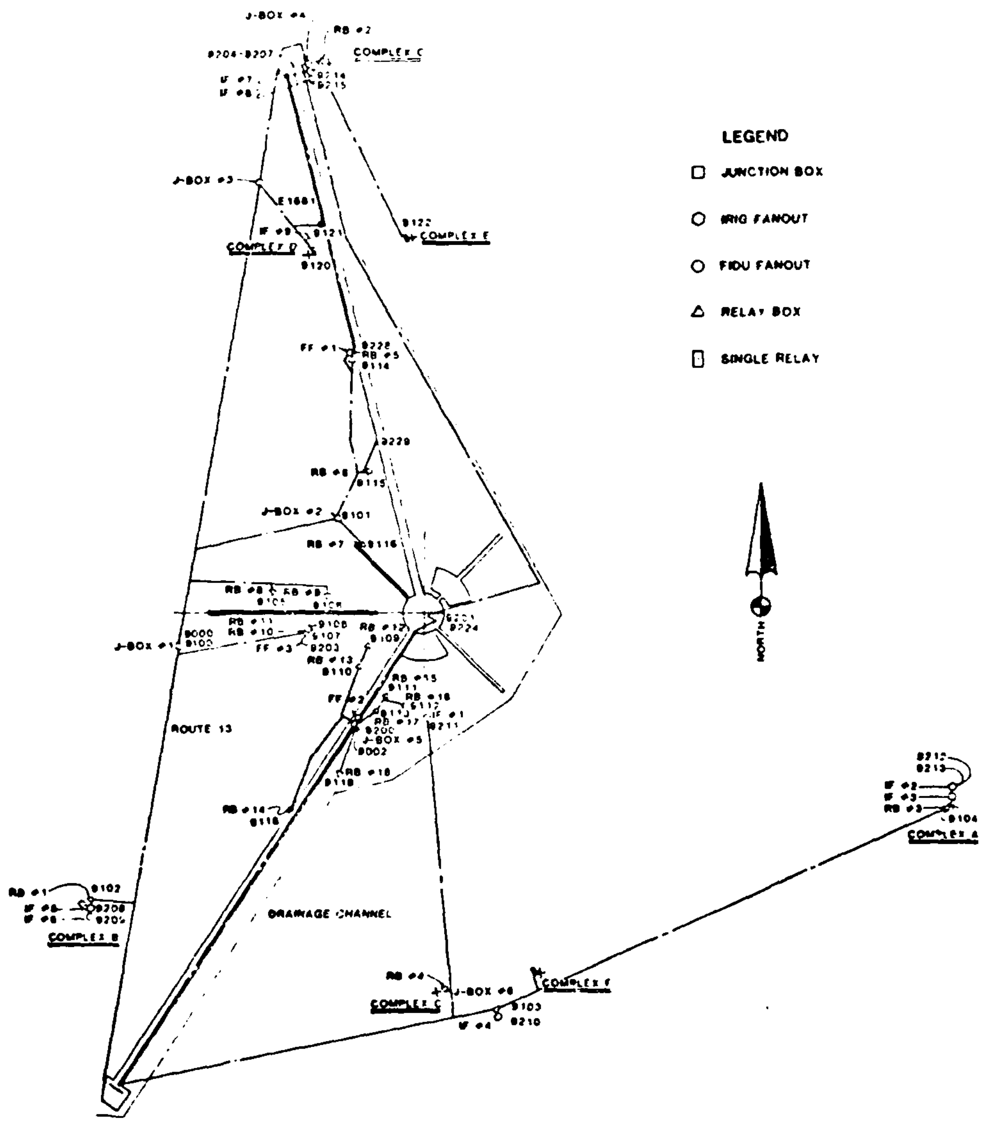

Figure 3-9. T&F cable plan.

Table 3-3. TRS burn characteristics.

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systems used on MILL RACE. Each of the four TRS systems had their pilot lights lighted automatically at T-3 minutes as a result of a manual signal sent from the TRS control trailer (S1) in the South Instrumentation Park. At T-2:45 another manual signal was sent which closed the vents. At T-30 seconds, a signal from the T&F trailer was received at the TRS control trailer which initiated the TRS timing signals sequence as shown in Table 3-4. At T+8 seconds, a manual signal sent from the TRS control trailer opened the vents.

Table 3-4. TRS timing signals.

Function	Function Time (s) at TRS Unit			
	NAVSEA	BRL	UK ARMY	UK NAVY
Pressurized Aluminum (Al) and Liquid Oxygen (LOX) Nitrogen (N_2) Purge	-30	-30	-30	-30
N_2 High Speed On and LOX Flow	-13.3 (nozzles 1&4) -10.3 (nozzles 2&3)	-7.8	-8.4	-7.9
Al	-4.7	-2.8	-2.9	-3.4
LOX Off Al Off N_2 High Speed Off Pilot Lights Off Tank Pressure Off N_2 Purge Off	-2.3	-1.7	-1.4	-1.9

Each of the four nozzle TRS systems ignited properly, burned the required time, and provided the predicted thermal levels within the predicted limits. On the eight-nozzle system, the aluminum valve for nozzles 5 and 6 did not open. Because the nozzles were interior ones, the fluence provided by the other six nozzles was sufficient to meet the experiment objectives. Figure 3-10 shows a TRS system above ground and Figure 3-11 shows the system placed in a TRS pit.

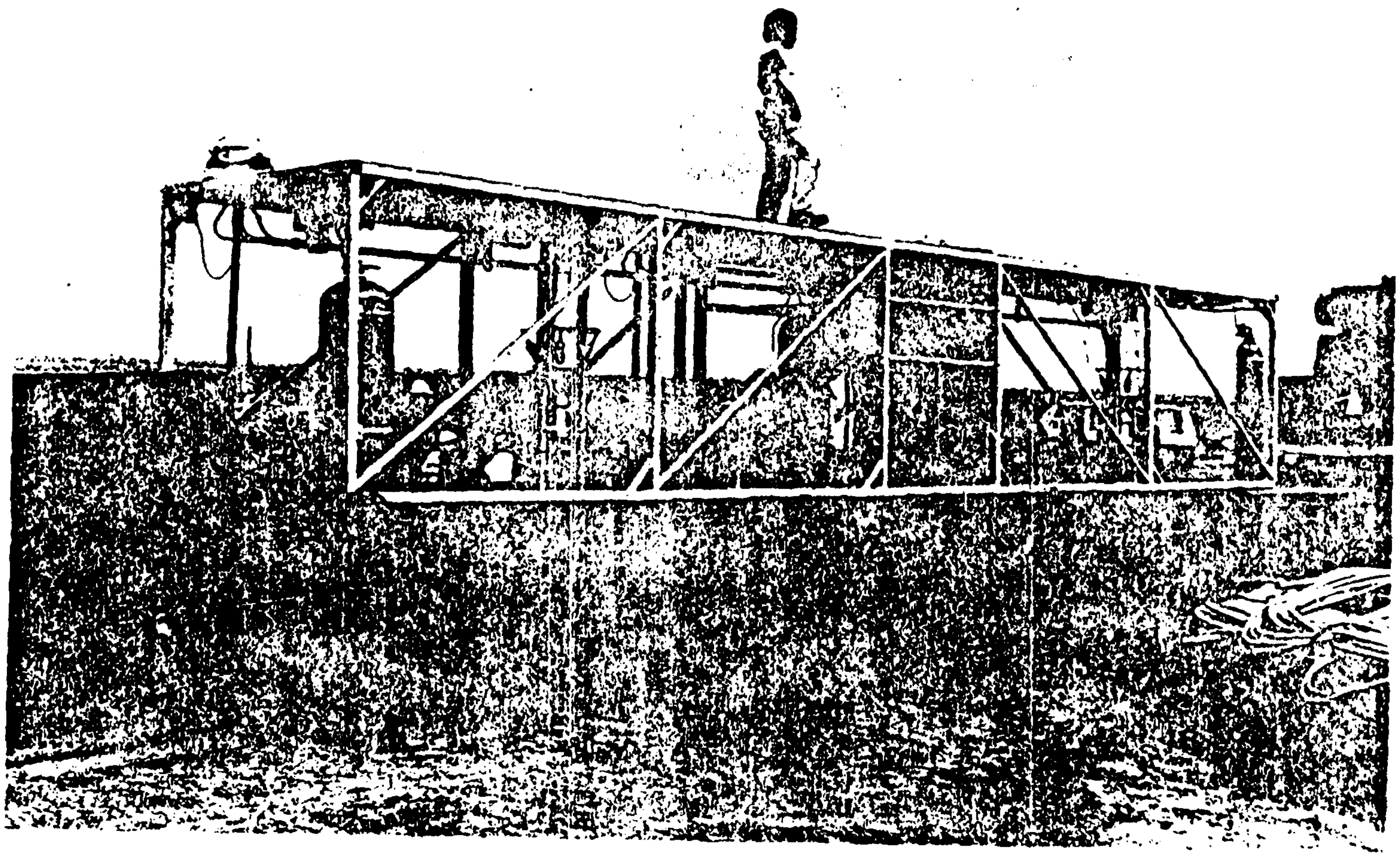


Figure 3-10. TRS system (above ground).

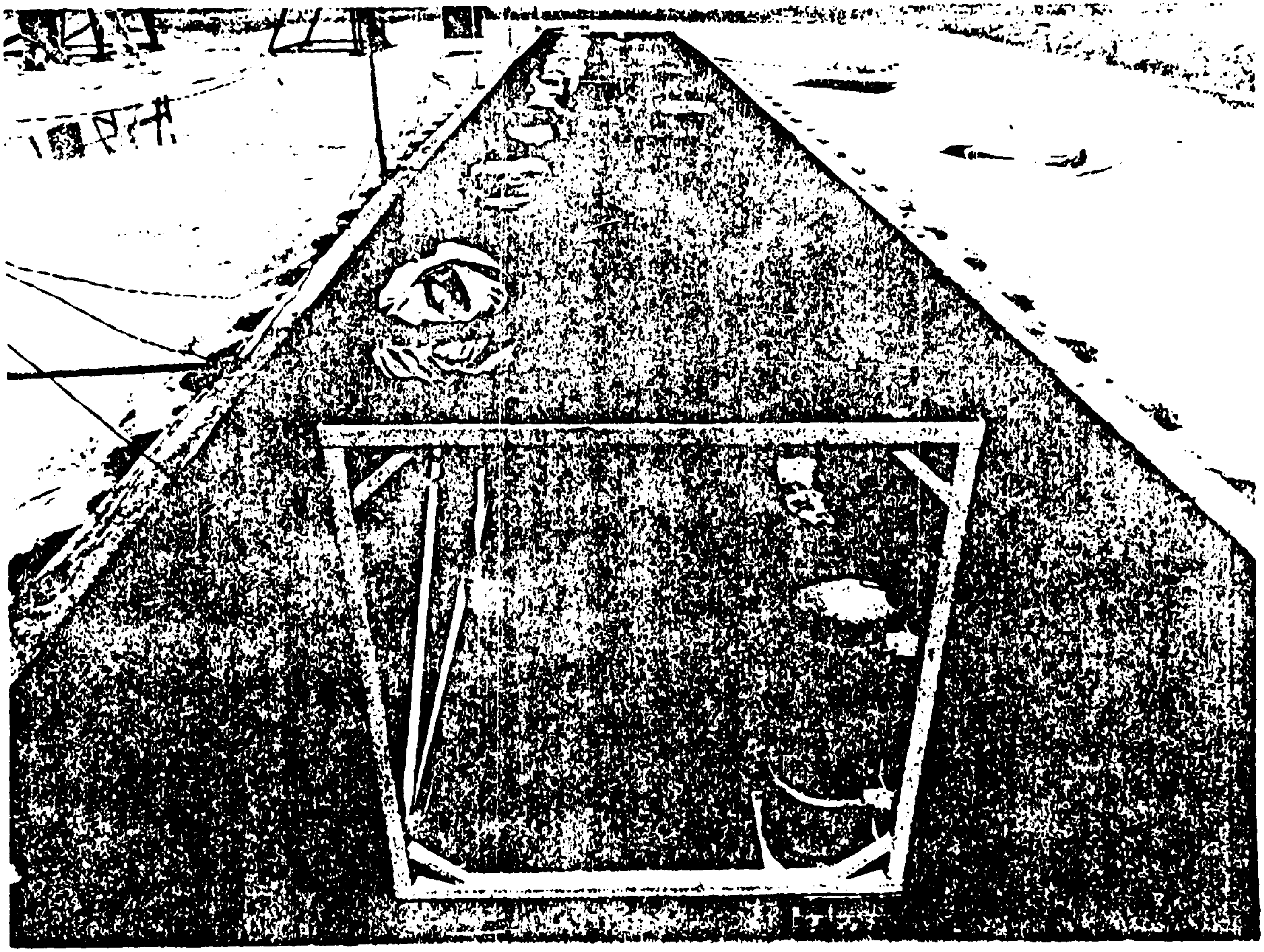


Figure 3-11. TRS system (below ground) without cover plates installed.

3-6 ANFO AND TRS DETONATION DIAGNOSTICS.

Various high-speed cine cameras were used to record ANFO detonation, and ANFO and TRS diagnostic phenomenology. Seven camera bunkers were positioned around the testbed with the cameras focused on the GZ area for ANFO diagnostics. Three primary bunkers were positioned on radials extending from GZ that were 120° apart. Two of the bunkers were 6,000 feet (1.83 km) from GZ while the third was 4800 feet (1.46 km) away. Four other bunkers were positioned closer in at 4,000 feet (1.22 km) and looked at GZ from opposite directions. These four bunkers recorded ejecta phenomenology. Bunker G also housed two streak cameras to record booster detonation sequence. One high-speed cine camera was positioned in front of each of the four TRS pits and one was positioned 4,000 feet (1.22 km) from GZ on the 270° radial and provided coverage of all TRS pits. Table 3-5 is a list of the ground cameras used. Figure 3-12 shows the diagnostic camera layout with the exception of the four positioned in front of the TRS pits. Figure 3-13 is an artist's concept of the testbed with the drones flying and showing a typical diagnostic camera complex. Figure 3-14 shows a typical diagnostic camera station. As shown in the photograph, the cameras were housed in a plywood structure for protection from weather and elevated above the surrounding testbed terrain to provide a clear line of sight to GZ and selected radials. The plywood construction eliminated the reflection of the airblast overpressure from the structure to the cameras and their mounts. Figures 3-15 through 3-20 show the coverage of each of the cameras from the seven complexes. The location of the targets (A1, A2, ..., B1, B2 ..., etc.) is shown in Figure 3-12.

Diagnostic cameras recorded visual information that gave (1) sequence of booster detonation, (2) ANFO detonation velocity, (3) uniformity of ANFO stack burn (light breakout), (4) fireball growth and anomalies, (5) shockwave and dust jets, (6) shockwave velocity and overpressures, (7) ejecta angles and velocities, and (8) cloud growth. The four TRS diagnostic cameras recorded ignition sequence, fireball growth and size, length of burn, and cloud formation and dissipation.

The aerial photographic coverage was provided by the Williamson Aircraft Company and was accomplished by using high speed, stereo, and still cameras to give:

a. overhead, high speed and real time cine of the detonation, and
b. pre- and post-detonation photogrammetric documentation of the test area both in black and white and in color.

Table 3-6 is a list of aerial cameras used on MILL RACE.

3-7 CABLE SYSTEMS.

The multipurpose system used on MILL RACE (1) connected recorders with sensors at experiment stations to record data, (2) provided electrical power to the instrumentation parks, and (3) transmitted timing signals. The cable system was designed to minimize crossed cables, to minimize the amount of cable used (shortest runs possible), to minimize the number of connection points and to eliminate unwanted noise. To accomplish these

Table 3-5. Diagnostic photography for MILL RACE.

Camera Number	Camera Location[a]	Mount	Camera Type	Lens Focal Length	Horizontal Coverage (from GZ)	Vertical Coverage (above ground level)	Timing	Frame Rate/ Second	Data Requirement[b]	Coverage Segment(s)	Orientation
E1586	B	pcp[c]	16 mm Hycam	3 in	±336.8 ft	374 ft	IRIG A	5 k	1	T-5 to T+20[d]	Center on GZ and elevate 1 degree 30 min (shockwave targets B3 and B4 visible)
E1587	B	pcp	16 mm Locam	16 mm	±1531 ft	1861 ft	IRIG A	200	2	T-5 to T+20	Center on GZ and elevate 8 degrees (no shockwave targets visible)
E1617	B	pcp	35 mm 4C	10 in	±239 ft	265 ft	IRIG A	2.5 k	3	T-4 to T+6	Center on Pole B2 and elevate 1 degree 12 min (shockwave targets B1 through B3 visible)
E1713	B	2 tier	70 mm Dynafax	165 mm	±145 ft	119 ft	Internal	26 k	4	T-0 to T+0.045	Center stack in field of view (no shockwave targets visible)
E1748	TRS	pcp	12 mm	16 mm	---	---	Local Oscillator	400	5	T-10 to T+10	Center on UK Navy TRS array
E1749	TRS	pcp	12 mm	16 mm	+40 ft	120 ft	Local Oscillator	400	5	T-10 to T+10	Center on BRL TRS array
E1750	TRS	pcp	12.5 mm	16 mm	---	---	Local Oscillator	400	5	T-10 to T+10	Center on UK Army TRS array
E1751	TRS	pcp	12.5 mm	16 mm	+100 ft	100 ft	Local Oscillator	400	5	T-10 to T+10	Center on Navy TRS array
E1759	A	2 tier	70 mm 10 A	4 in	±1687 ft	3166 ft	IRIG A	30	6	T-5 to T+180	Center on GZ and elevate 12 degrees (scaling targets and shockwave targets A1 through A9 visible)
E1760	B	2 tier	70 mm 10A	3 in	±1799 ft	3078 ft	IRIG A	30	6	T-5 to T+180	Center on GZ and elevate 12 degrees (scaling targets and shockwave targets B1 through B9 visible)
E1761	C	2 tier	70 mm 10A	4 in	±1687 ft	3166 ft	IRIG A	30	6	T-5 to T+180	Center on GZ and elevate 12 degrees (scaling targets and shockwave targets C1 through C12 visible)
E1762	A	2 tier	70 mm 10B	10 in	±675 ft	1150 ft	IRIG A	360	7	T-6 to T+12	Center on GZ and elevate 4 degrees 18 min (scaling targets and shockwave targets A1 through A6 visible)

Table 3-5. Diagnostic photography for MILL RACE (continued).

Camera Number	Camera Location[a]	Mount	Camera Type	Lens Focal Length	Horizontal Coverage (from GZ)	Vertical Coverage (above ground level)	Timing	Frame Rate/ Second	Data Requirement[b]	Coverage Segment(s)	Orientation
E1763	B	2 tier	70 mm 10B	10 in	±540 ft	923 ft	IRIG A	360	7	T-5 to T+12	Center on GZ and elevate 4 degrees 18 min (scaling targets and shockwave targets B2 through B5 visible)
E1764	C	2 tier	70 mm 10B	10 in	±675 ft	1150 ft	IRIG A	360	7	T-5 to T+12	Center on GZ and elevate 4 degrees 18 min (scaling targets and shockwave targets C2 through C7 visible)
E1765	G	pcp	70 mm 10A	10 in	100 to 1,000 ft left	829 ft	IRIG A	60	8	T-5 to T+30	Center on a point 550 ft from GZ measured along 260-degree shockwave ref pole radial and elevate 5 degrees (scaling targets and shockwave targets D5 through D8 visible)
E1766	F	pcp	70 mm 10A	10 in	100 to 1,000 ft right	827 ft	IRIG A	60	8	T-5 to T+30	Center on a point 550 ft from GZ measured along 80-degree shockwave ref pole radial and elevate 5 degrees (scaling targets and shockwave targets D1 through D3 visible)
E1767	D	pcp	70 mm 10A	10 in	100 to 1,000 ft right	823 ft	IRIG A	60	8	T-5 to T+30	Center on a point 550 ft from GZ measured along 260-degree shockwave ref pole radial and elevate 5 degrees (scaling targets and shockwave targets C5 through C8 visible)
E1768	E	pcp	70 mm 10A	10 in	100 to 1,000 ft left	823 ft	IRIG A	60	8	T-5 to T+30	Center on a point 550 ft from GZ measured along 80-degree shockwave ref pole radial and elevate 5 degrees (scaling targets and shockwave targets C1 through C4 visible)
E1769	A	2 tier	35 mm 4C (1/2 frame)	10 in	±299 ft	160 ft	IRIG A	5 k	9	T-4 to T+6	Center on GZ and elevate 30 degrees (scaling targets and shockwave targets A3 and A4 visible)
E1770	B	2 tier	35 mm 4C (1/2 frame)	6 in	±400 ft	182 ft	IRIG A	5 k	9	T-4 to T+6	Center on GZ and elevate 30 degrees (scaling targets and shockwave targets B3 and B4 visible)
E1771	C	2 tier	35 mm 4C (1/2 frame)	10 in	±299 ft	160 ft	IRIG A	5 k	9	T-4 to T+30	Center on GZ and elevate 30 degrees (scaling targets and shockwave targets C4 and C5 visible)

Table 3-5. Diagnostic photography for MILL RACE (continued).

Camera Number	Camera Location[a]	Mount	Camera Type	Lens Focal Length	Horizontal Coverage (from GZ)	Vertical Coverage (above ground level)	Timing	Frame Rate/Second	Data Requirement[b]	Coverage Segment(s)	Orientation
E1772	A	2 tier	16 mm Hycam	10 to 20 in	±63 ft	59 ft	IRIG A	11 k	10	T-7 to T+1	Center stack in field of view (no shockwave targets visible)
E1773	B	2 tier	16 mm Hycam	10 to 20 in	±50 ft	50 ft	IRIG A	11 k	10	T-7 to T+1	Center stack in field of view (no shockwave targets visible)
E1774	C	2 tier	16 mm Hycam	10 to 20 in	±63 ft	59 ft	IRIG A	11 k	10	T-7 to T+1	Center stack in field of view (no shockwave targets visible)
E1775	A	2 tier	16 mm Hycam (1/4 frame)	6 in	±210 ft	52 ft	IRIG A	44 k	4	T-7 to T+1	Center stack in field of view (shockwave targets A3 and A4 visible)
E1776	B	2 tier	16 mm Hycam (1/4 frame)	6 in	±168 ft	44 ft	IRIG A	44 k	4	T-7 to T+1	Center stack in field of view (no shockwave targets visible)
E1777	A	2 tier	16 mm Hycam (1/2 frame)	10 in	±125 ft	59 ft	IRIG A	22 k	4	T-7 to T+1	Center stack in field of view (no shockwave targets visible)
E1778	B	2 tier	16 mm Hycam (1/2 frame)	10 in	±101 ft	50 ft	IRIG A	22 k	4	T-7 to T+1	Center stack in field of view (no shockwave targets visible)
E1779	A	2 tier	35 mm 4C	10 in	50 to 650 ft right	328 ft	IRIG A	2.5 k	11	T-4 to T+6	Center on a point 350 ft from GZ measured along 20-degree shockwave ref pole radial and elevate 1 degree 12 min (shockwave targets A4 through A6 visible)
E1780	A	2 tier	35 mm 4C	10 in	620 to 1,235 ft right	331 ft	IRIG A	2.5 k	11	T-4 to T+6	Center on a point 925 ft from GZ measured 20-degree shockwave ref pole radial and elevate 1 degree 12 min (shockwave targets A7 through A9 visible)
E1781	B	2 tier	35 mm 4C	10 in	358 to 845 ft right	267 ft	IRIG A	2.5 k	11	T-4 to T+6	Center on Pole B6 and elevate 1 degree 12 min (shockwave targets B5 through B7 visible)
E1782	B	2 tier	35 mm 4C	10 in	752 to 1,252 ft right	270 ft	IRIG A	2.5 k	11	T-4 to T+6	Center on Pole B8 and elevate 1 degree 12 min (shockwave targets B7 through B9 visible)
E1783	G	pcp	70 mm CFA	92 in	±10.4 in	75 ft	IRIG A	122 ft/s	12	T-2 to T+5	Center boosters in field of view

Table 3-5. Diagnostic photography for MILL RACE (continued).

Camera Number	Camera Location[a]	Mount	Camera Type	Lens Focal Length	Horizontal Coverage (from G?)	Vertical Coverage (above ground level)	Timing	Frame Rate/ Second	Data Requirement[b]	Coverage Segment(s)	Orientation
E1784	G	pcp	70 mm CFA	92 in	±15.5 in	75 ft	IRIG A	122 ft/s	12	T-2 to T+5	Center boosters in field of view
E1785	C	2 tier	35 mm 4C	10 in	100 to 700 ft right	328 ft	IRIG A	2.5 k	11	T-4 to T+6	Center on Pole C6 and elevate 1 degree 12 min (shockwave targets C5 through C7 visible)
E1786	C	2 tier	35 mm 4C	10 in	695 to 1,310 ft right	332 ft	IRIG A	2.5 k	11	T-4 to T+6	Center on Pole C9 and elevate 1 degree 12 min (shockwave targets C8 through C10 visible)
E1835	C	2 tier	35 mm 4C	10 in	1,288 to 1,930 ft right	338 ft	IRIG A	2.5 k	13	T-4 to T+6	Center on Pole C12 and elevate 1 degree 12 min (shockwave targets C11 through C13 visible)
E1851	270° Radial	pcp	35 mm 4C	6 in			Local oscillator	1 k	5	T-6 to Ro	Center on four TRS experiments and stack

[a]Letters used here correspond with those used to label Complexes in Figure 3-12.

[b]
1 = fireball exposure (ir)
2 = fireball exposure
3 = shock arrival at 2071 LOADS and shockwave propagation
4 = light breakout and burn characteristics
5 = IRS nozzle performance
6 = cloud growth to 3,000 ft above ground level
7 = fireball characteristics, shockwave separation, shockwave propagation
8 = ejecta trajectory in two 180-degree directions
9 = fireball growth and characteristics
10 = light breakout
11 = shock front propagation
12 = booster detection sequence
13 = shock front propagation at TRS

[c]pcp = portable concrete pedestal

[d]T = time from blast (in seconds)

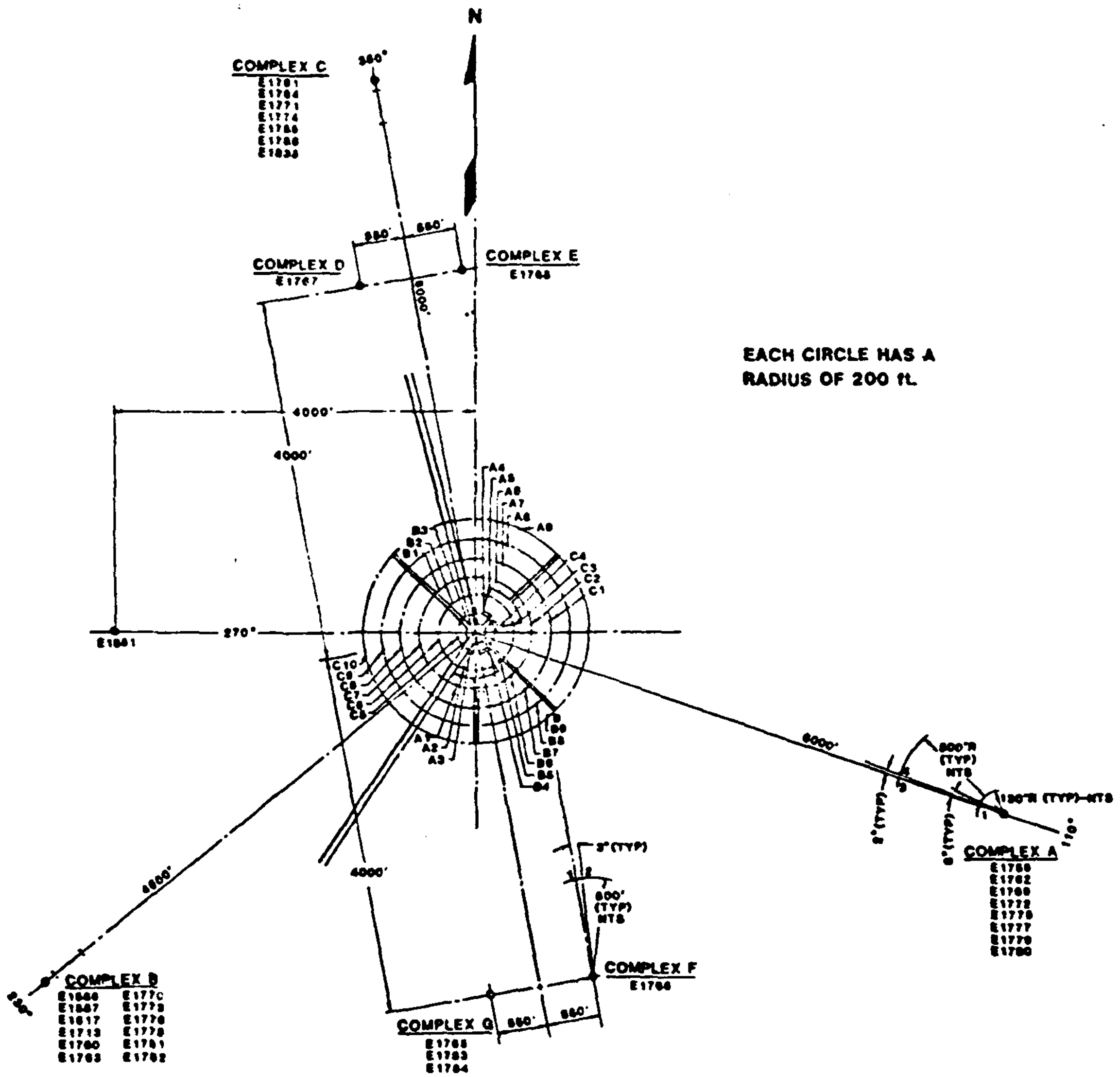


Figure 3-12. MILL RACE diagnostic camera locations.

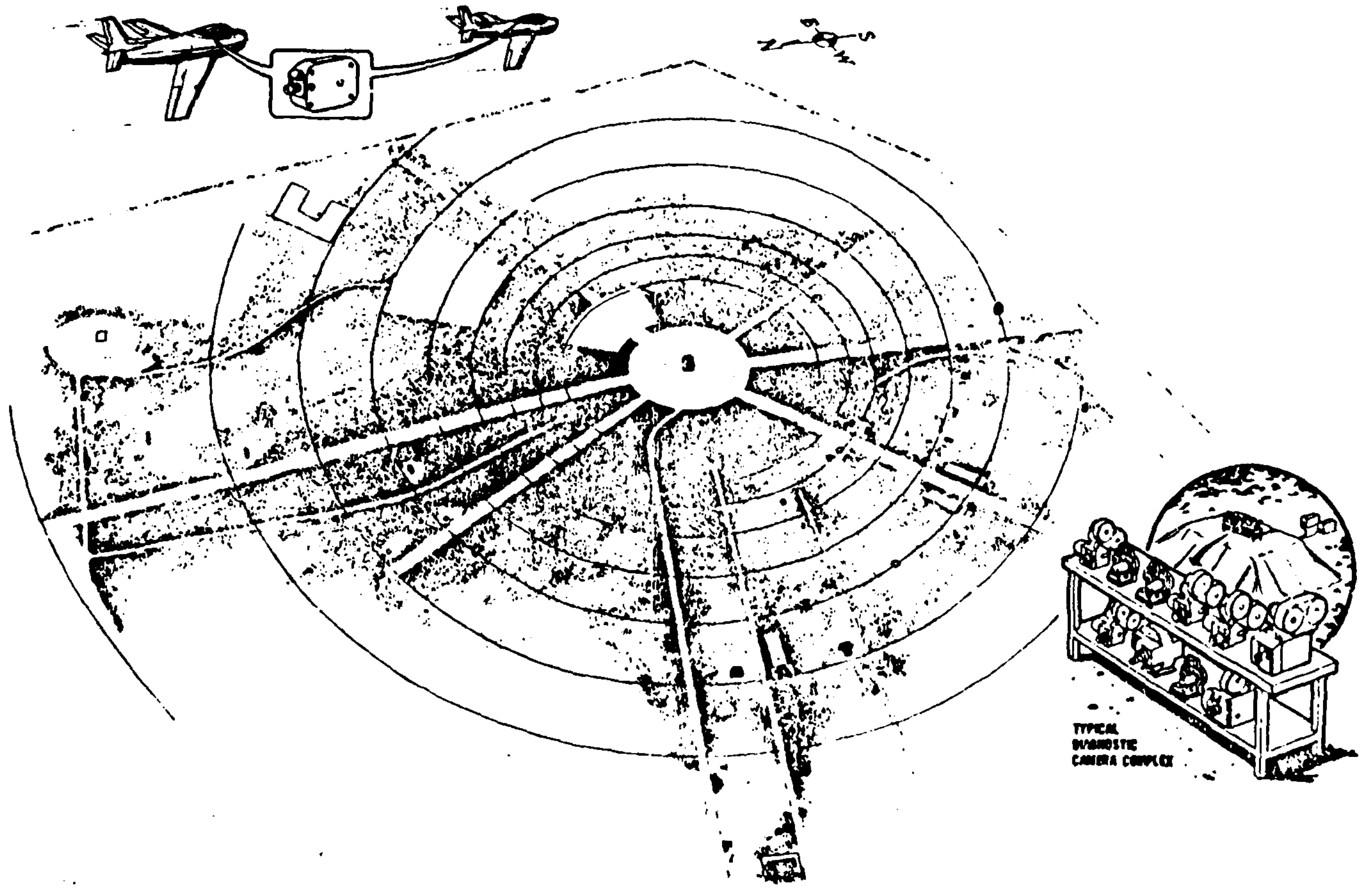


Figure 3-13. Artist's concept of MILL RACE testbed with camera complex and drones.

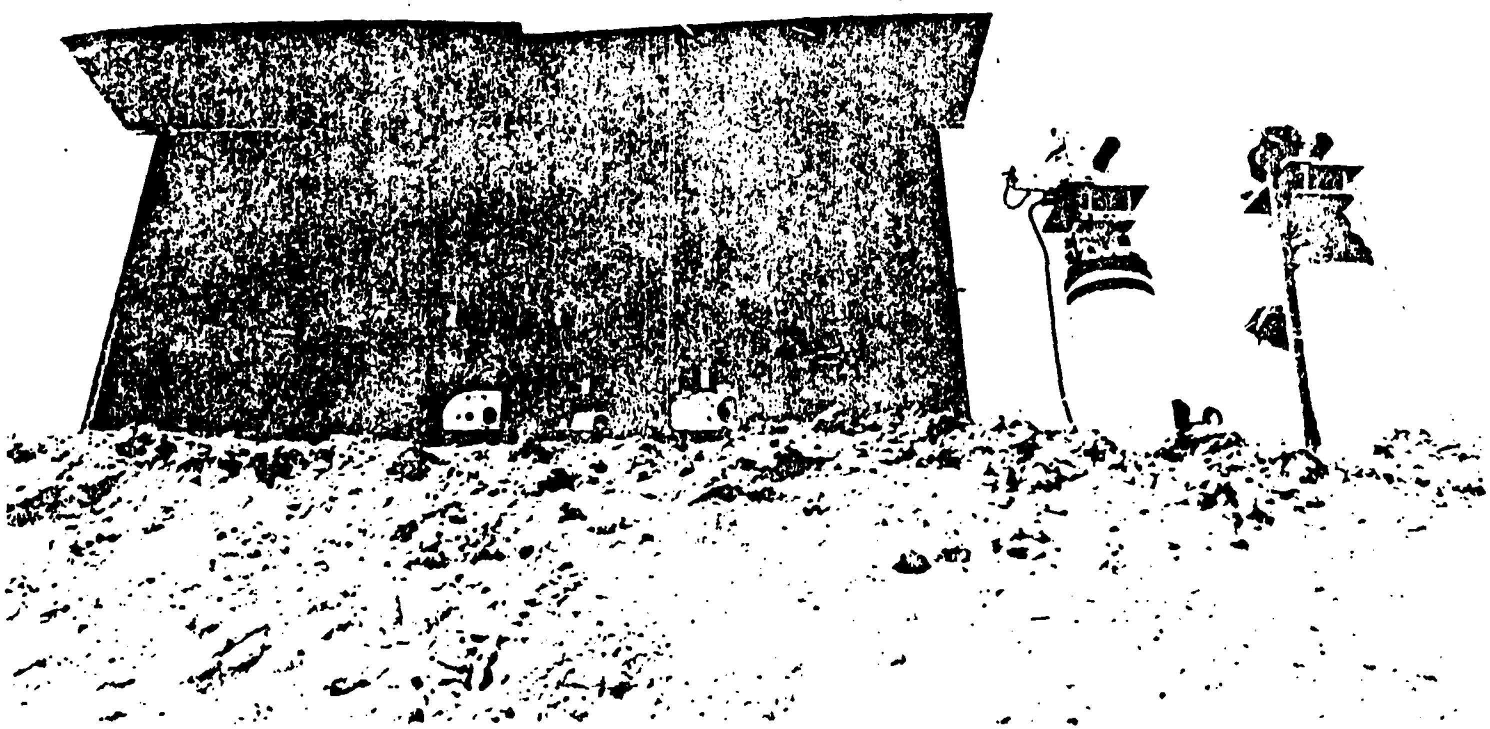
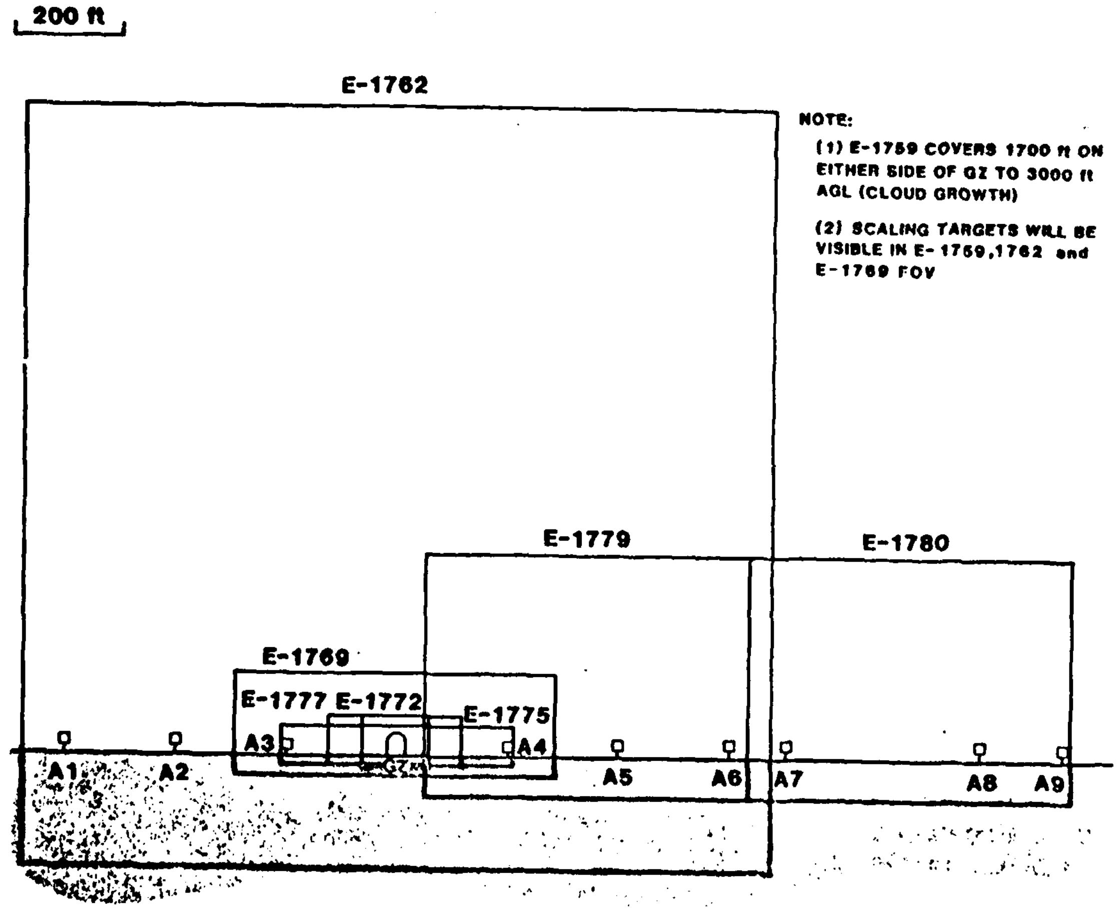


Figure 3-14. Diagnostic camera station (typical).



NOTE:

(1) E-1759 COVERS 1700 ft ON EITHER SIDE OF GZ TO 3000 ft AGL (CLOUD GROWTH)

(2) SCALING TARGETS WILL BE VISIBLE IN E-1759,1762 and E-1769 FOV

Figure 3-15. Camera coverage from Complex A.

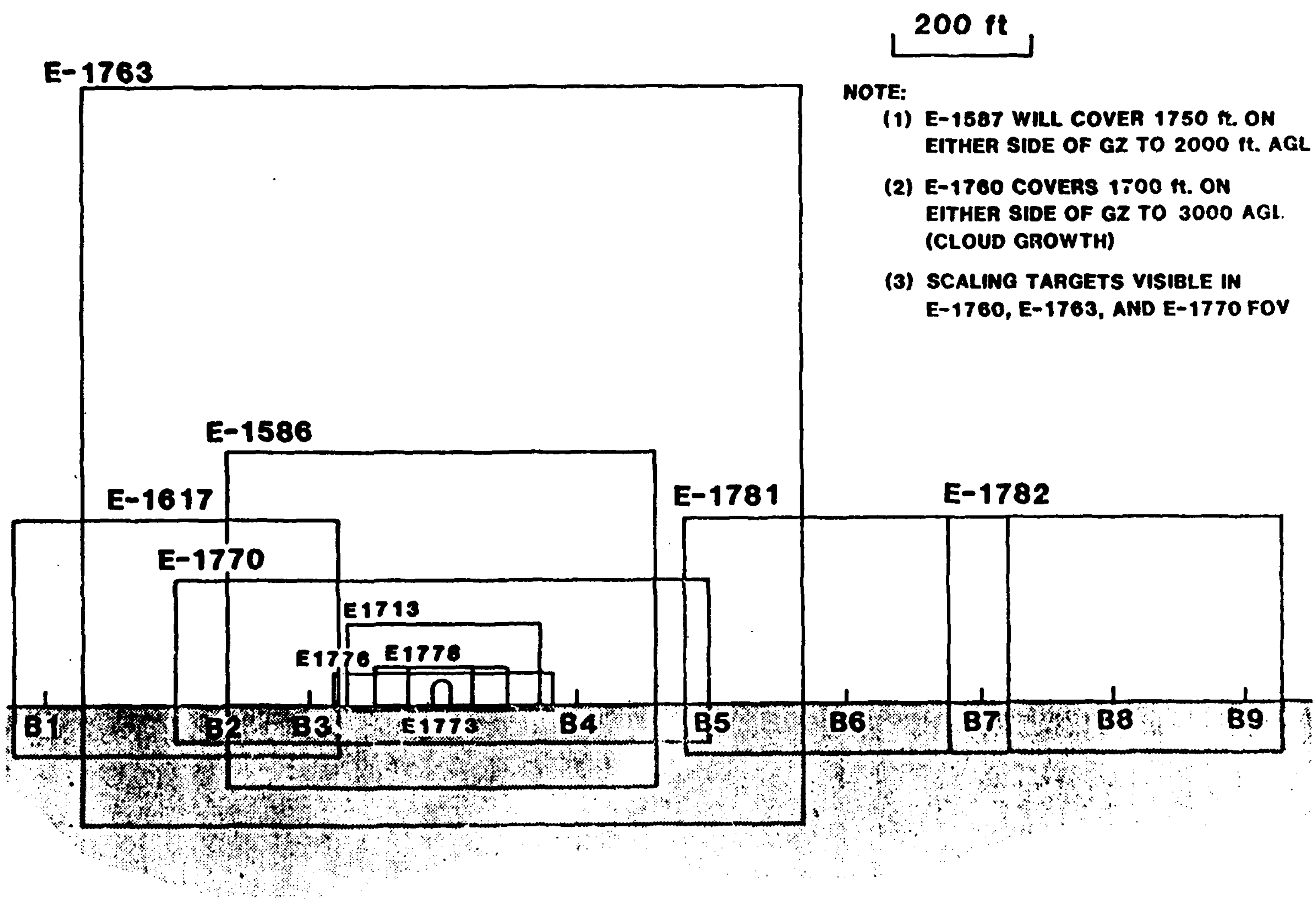


Figure 3-16. Camera coverage from Complex B.

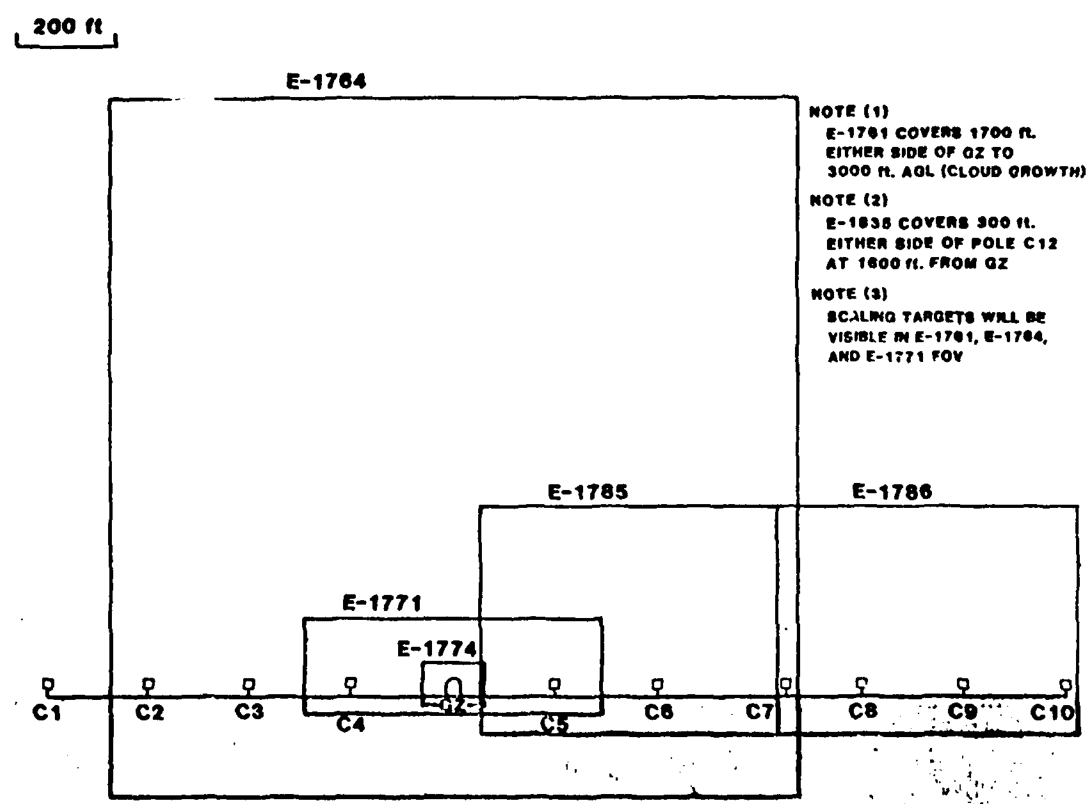


Figure 3-17. Camera coverage from Complex C.

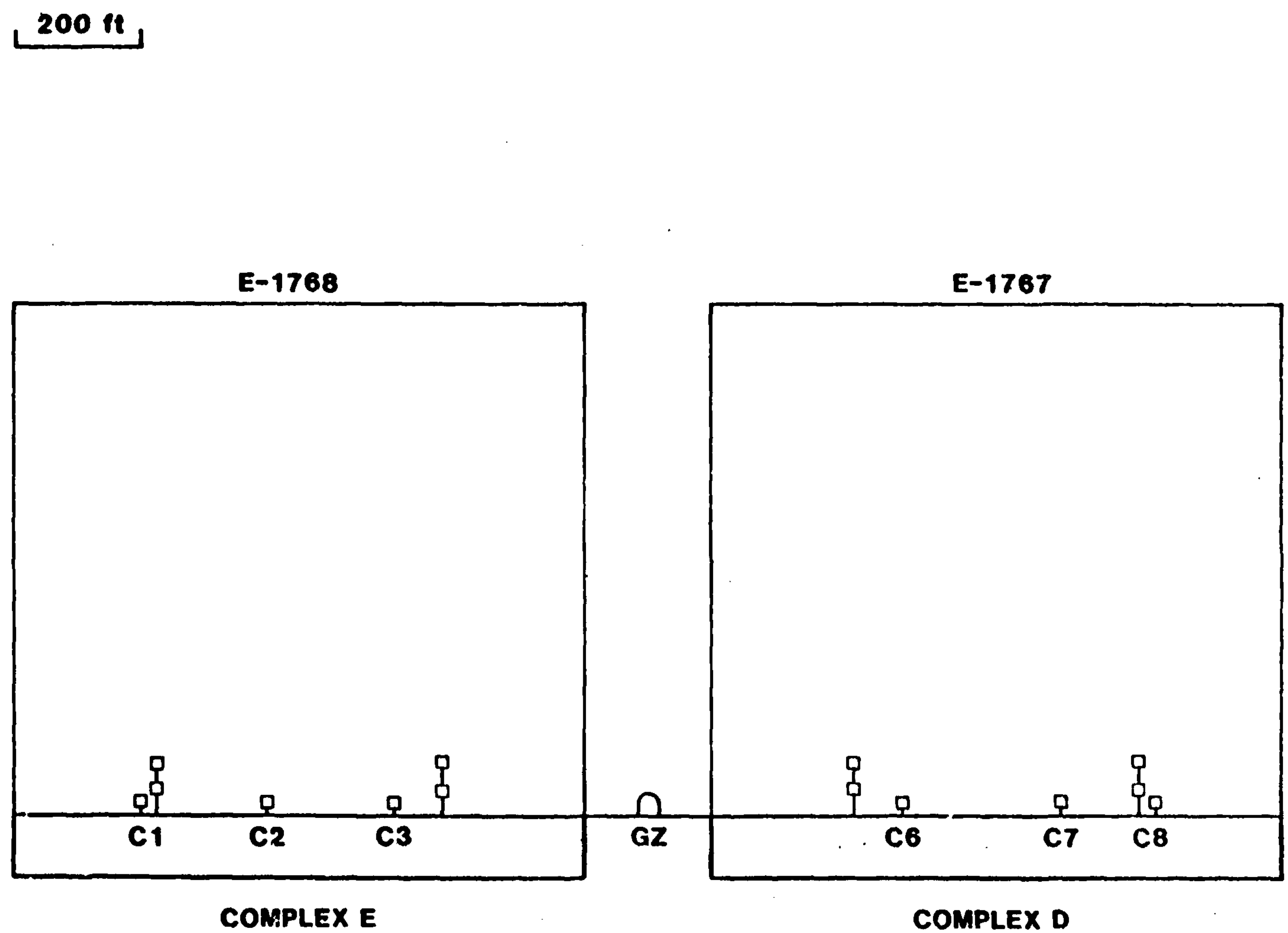


Figure 3-18. Camera coverage from Complex D and Complex E.

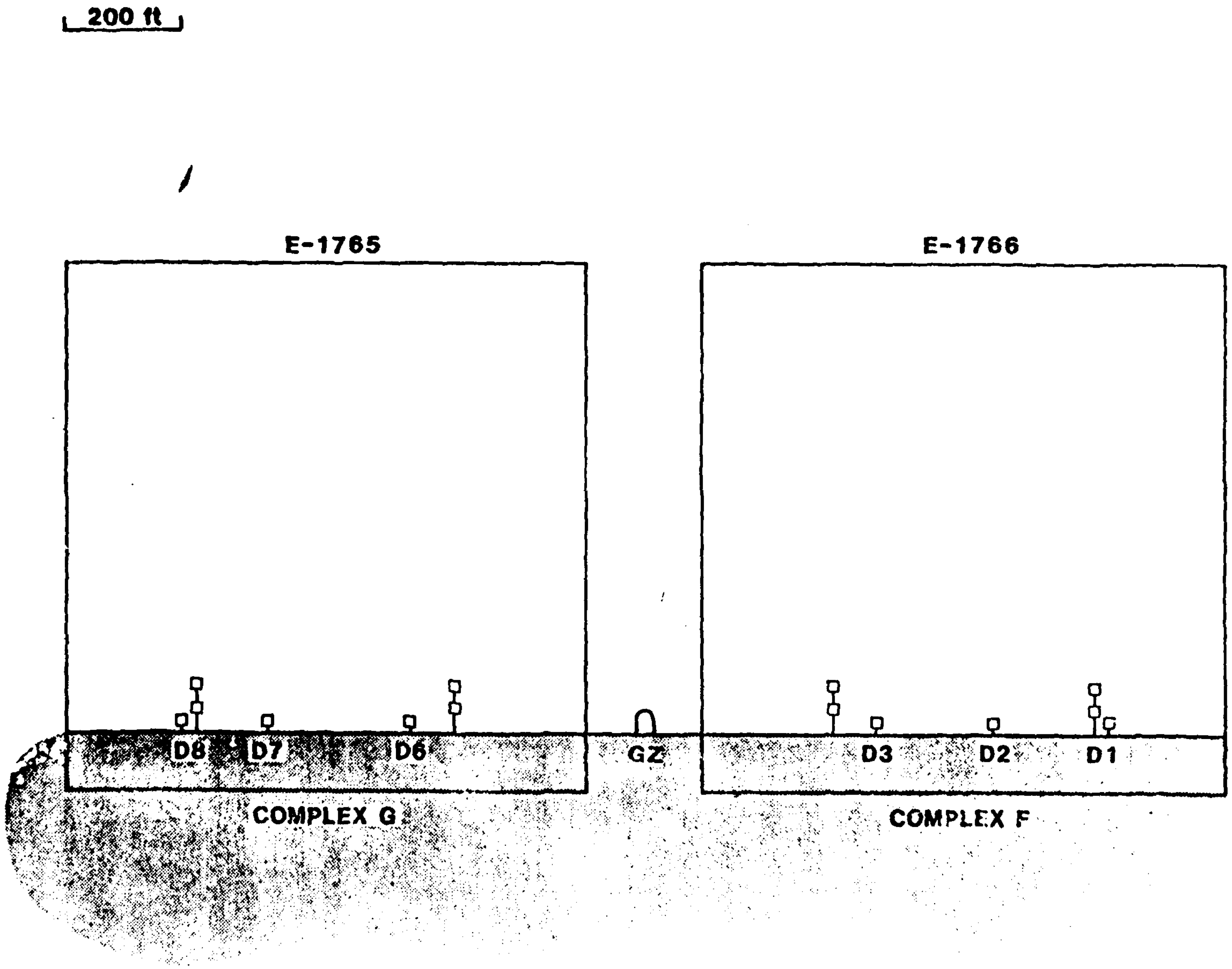


Figure 3-19. Camera coverage from Complex F and Complex G.

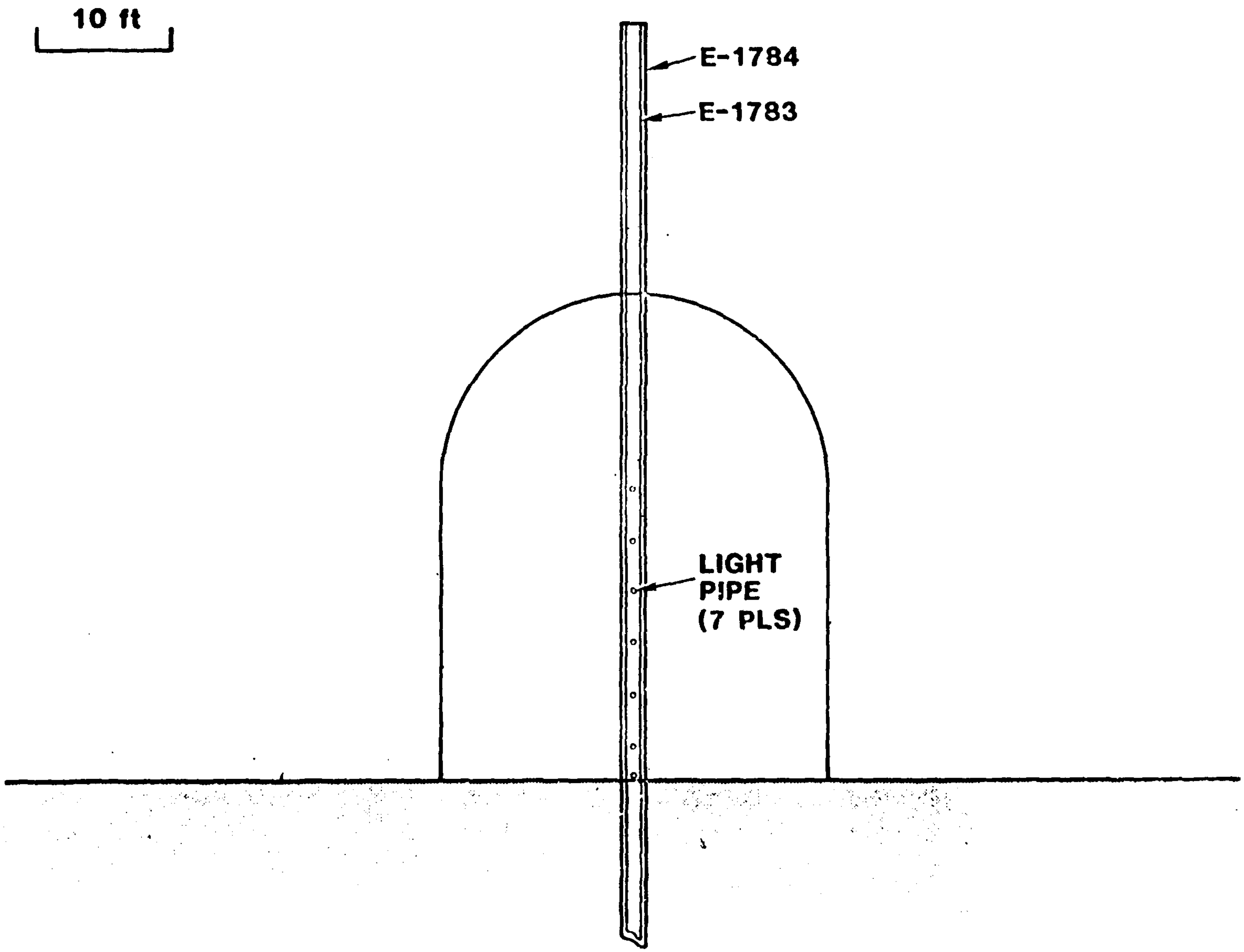


Figure 3-20. Camera coverage from Complex G.

Table 3-6. Aerial cameras.

Camera Type	Frame Rate	Lens	Purpose
70mm Hulcher	10 fps[a]	381mm	Shock wave and anomaly
70mm Hulcher	10 fps	177mm	Ejecta and jets
16mm Milliken	400 fps	75mm	Diagnostic
16mm Milliken	400 fps	150mm	Diagnostic
16mm Milliken	200 fps	50mm	Diagnostic
16mm Milliken	24 fps	12mm	Documentary
16mm Fastax	4000 fps	100mm	Diagnostic

[a]fps = frame per second

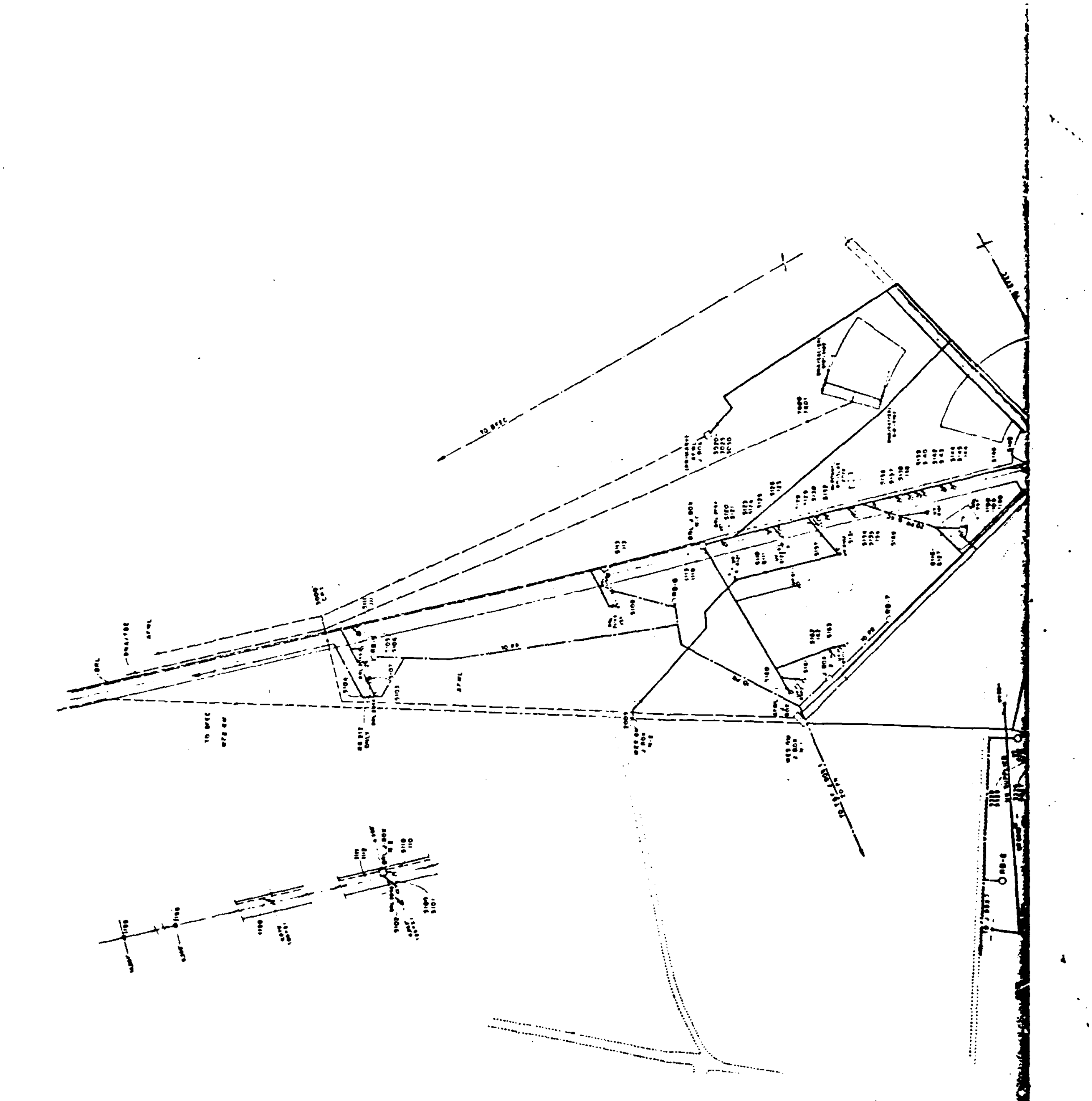
objectives, multiple pair, unspliced trunk cables were laid parallel to each other adjacent to the north and southwest gagelines and to the west end of the TRS (270°) radial. Trunk cables terminated at junction boxes located in close proximity to designated experiments. Single twisted pair or four conductor cable fanned out from the junction box directly to the sensor. A total of 162 trunk cables were installed along the two gagelines and from the west end of the TRS radial. Power cables ran directly to the instrumentation parks and no alternating current power was allowed on the testbed.

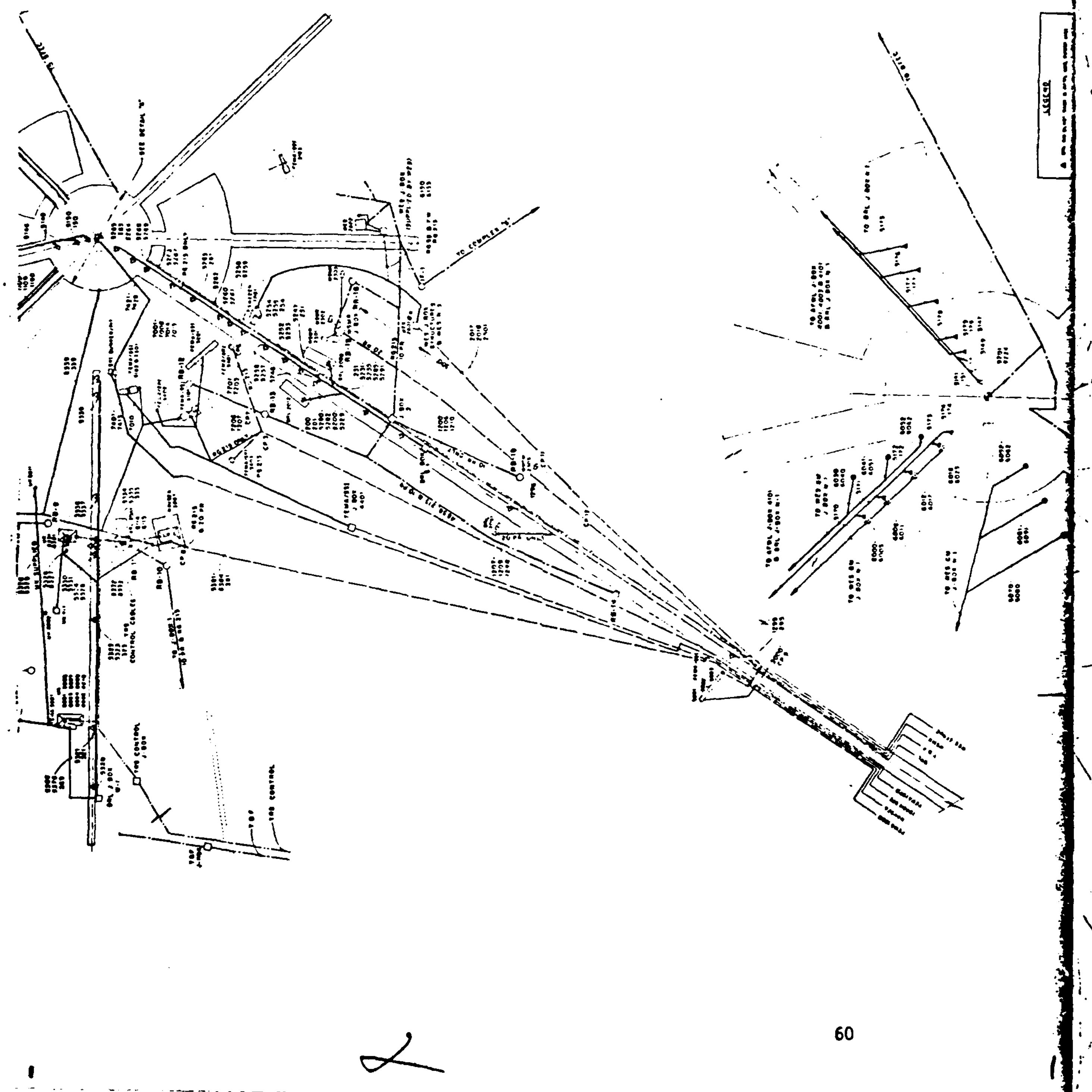
The cable coordinator arrived on site 16 March 1981 and began receiving cable from NTS and preparing cable trenches. The installation of trunk cable from instrumentation parks to forward junction boxes commenced on 27 April and was completed on 22 June 1981, on schedule. By 17 August 1981 all cables were laid from junction boxes to sensors with the exception of late add-on experiments. The cable laying effort for add-on experiments continued until approximately 1 week prior to event. Due to late delivery of switch boxes, power to the instrumentation and administration parks was delayed until 15 June 1981.

The MILL RACE cable plan is shown in Figure 3-21. The total amount of cable used on MILL RACE including cable for telephones was 1,515,425 feet (461.9 km). Table 3-7 lists each type cable and quantity that was used on MILL RACE.

3-8 DATA RECORDING FACILITIES.

Data, in the form of millivolt (mV) signals from the experiment sensors, were recorded on frequency modulation (FM) tape recorders located in instrumentation trailers. Because of the small signal and because the minimum input to the recorder is in the range of 0.25 volts, amplifiers to increase the size of the signal were used in series with the tape recorders. The MILL RACE data acquisition system was comprised of two basic systems. In most cases data ranging in frequency response from d.c. to 20 kHz was recorded utilizing





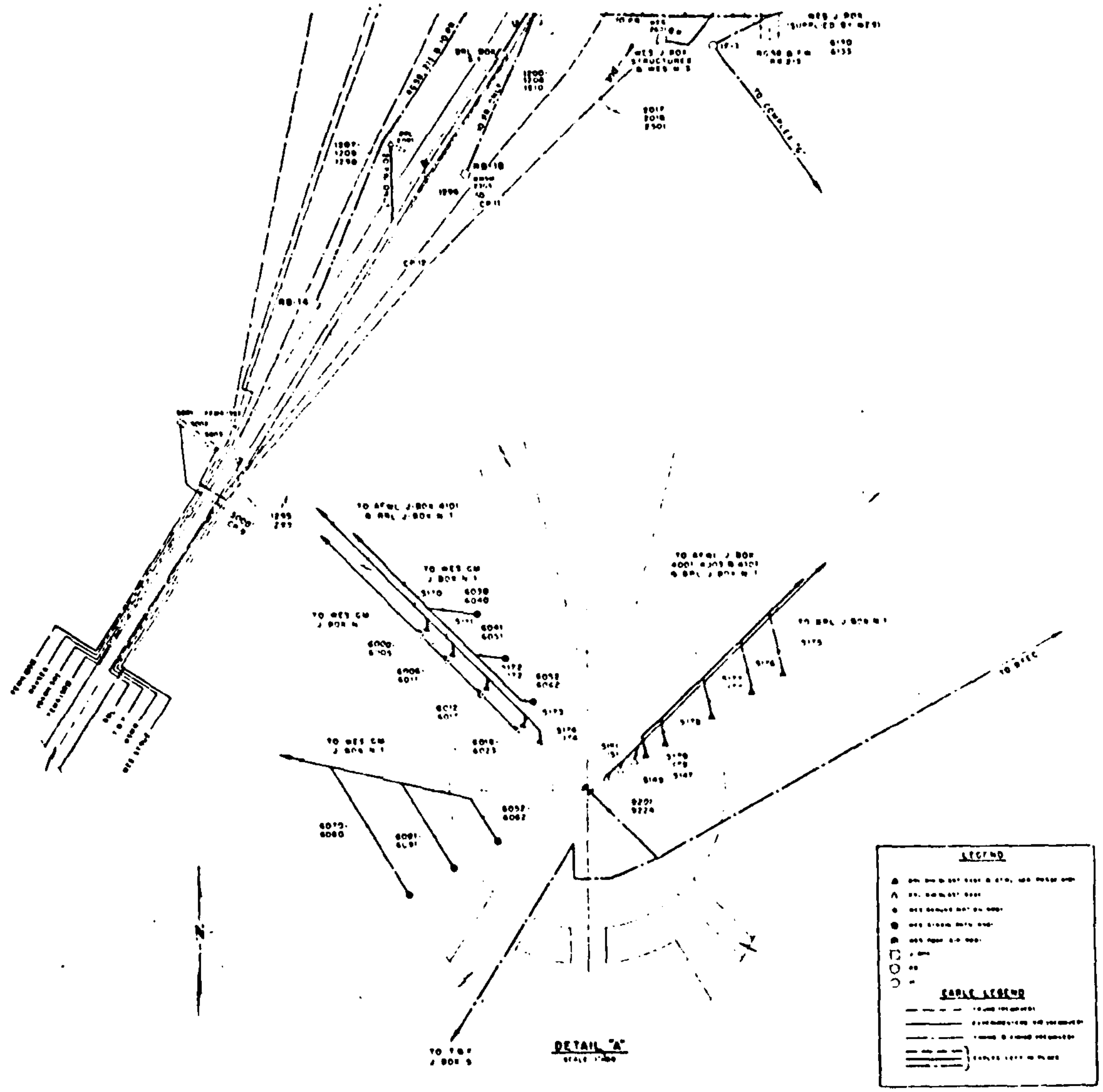


Figure 3-21. MILL RACE cable plan.

The location of the North and South Instrumentation Parks is shown on Figure 3-22 as is the location of the Administration Park. The layout of each park is shown in Figures 3-23, 3-24, and 3-25. By 7 June 1981, commercial power from Socorro Power and Light Cooperative, isolation transformers, distribution skids, and motor generator sets were installed. BFEC trailers were operational by 15 June 1981, and most experimenter trailers were onsite by 15 July 1981. Dry runs began on 17 August 1981.

Data were obtained from 48 experiments over 835 recording channels in 4 trailers in the North Instrumentation Park and 6 trailers in the South Instrumentation Park. Another 20 channels of data from DNA 6501 were telemetered to three SNLA recording locations on WSMR. Table 3-8 lists the trailers in the two parks, the recording agency, the experiments from which data were received, and the number of recording channels for each experiment. In addition the UK recorded 75 channels of information in self-contained tape recorders located near their experiments.

In the TRS control trailer (S1), panel meters provided information from thermocouplers at each of the TRS locations on the length of burn of each TRS nozzle. The length of the burn of each TRS provided the information needed to determine the thermal radiation that was produced. In addition there were passive calorimeters at each TRS location, which were used to provide additional information on the thermal radiation.

3-9 COMMUNICATION SYSTEMS.

The MILL RACE communication system consisted of telephones with intercom, radio ground-to-ground nets, and a video system. The communication procedures were operated in accordance with paragraphs 2400, 2700, and 2800 of Operations Directive 96301A (Appendix B-2).

3-9.1 Telephones and Intercom.

Telephone service was provided to all trailers in the administrative and instrumentation parks and to the cable yard. All lines had access to the rest of WSMR and, through the WSMR Main Post operator, to AUTOVON and the Federal Telecommunications System (FTS). The intercom system provided a communication capability among the several trailers in the Administration Park only.

3-9.2 Radio Systems.

There were two ground-to-ground nets. One was an administrative net provided by 48 portable radios and a base station. It was used for routine communications on the testbed and as the test control net. The second net was a "Safety Net" and was reserved for enforcing safety procedures and for use when hazardous materials were being transported or used on the testbed. MILL RACE test control was located in the FCDNA/TGD trailer with all base stations. The frequency used was 166.0 MHz.

Later in the fielding of MILL RACE, three discrete nets were established with a permanent base station at test control. The nets were between test control and the

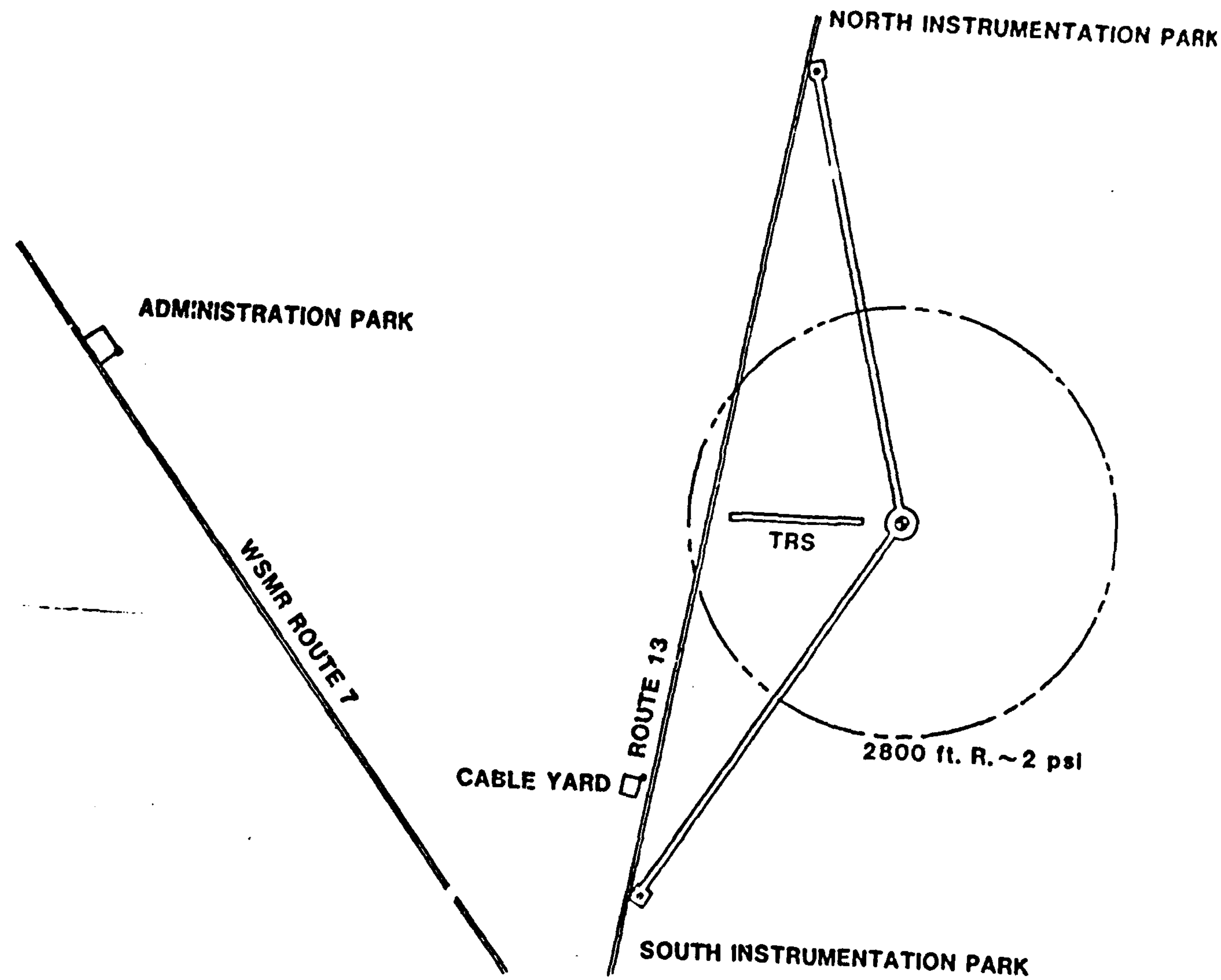


Figure 3-22. MILL RACE site.

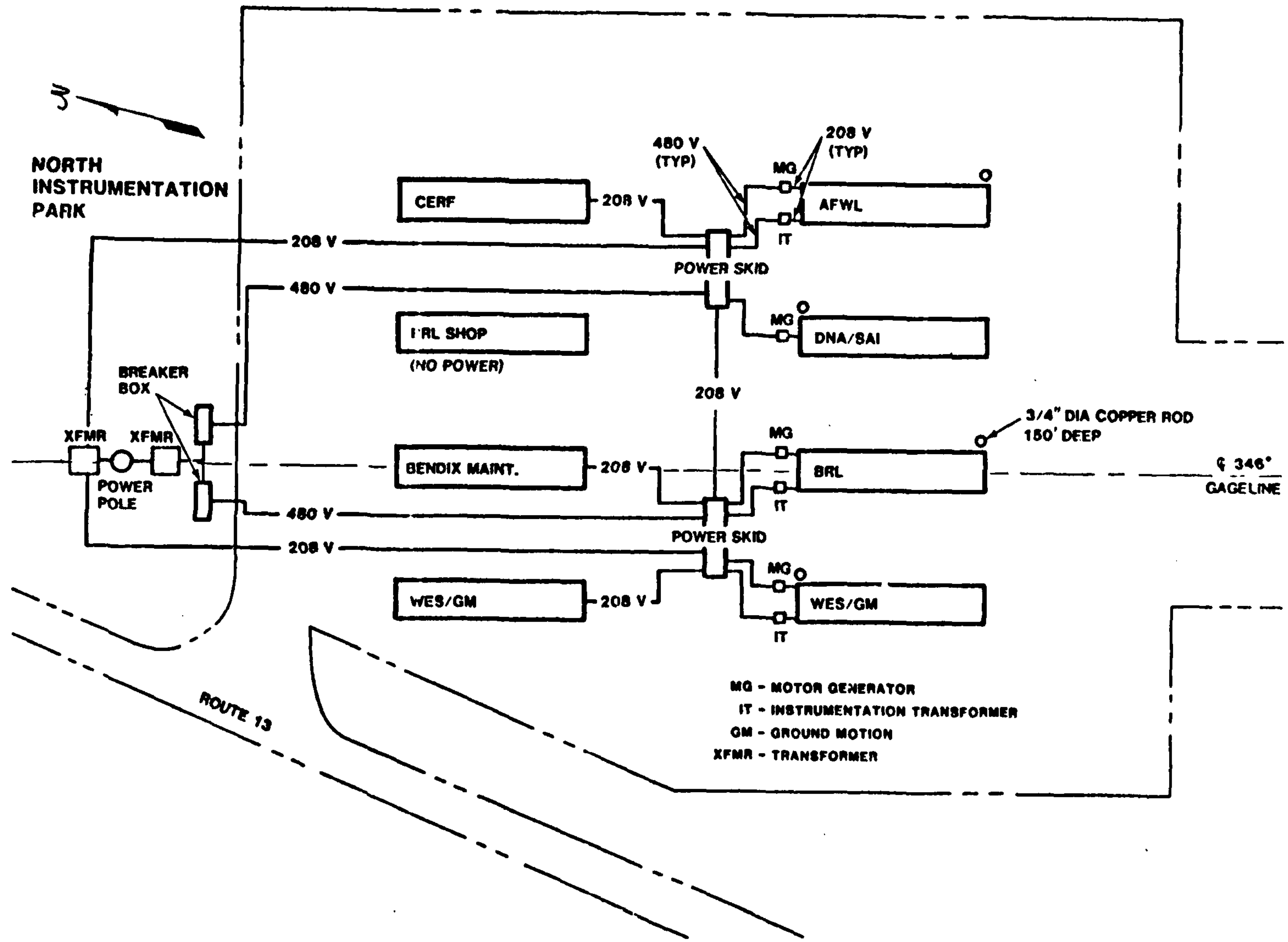


Figure 3-23. MILL RACE North Instrumentation Park.

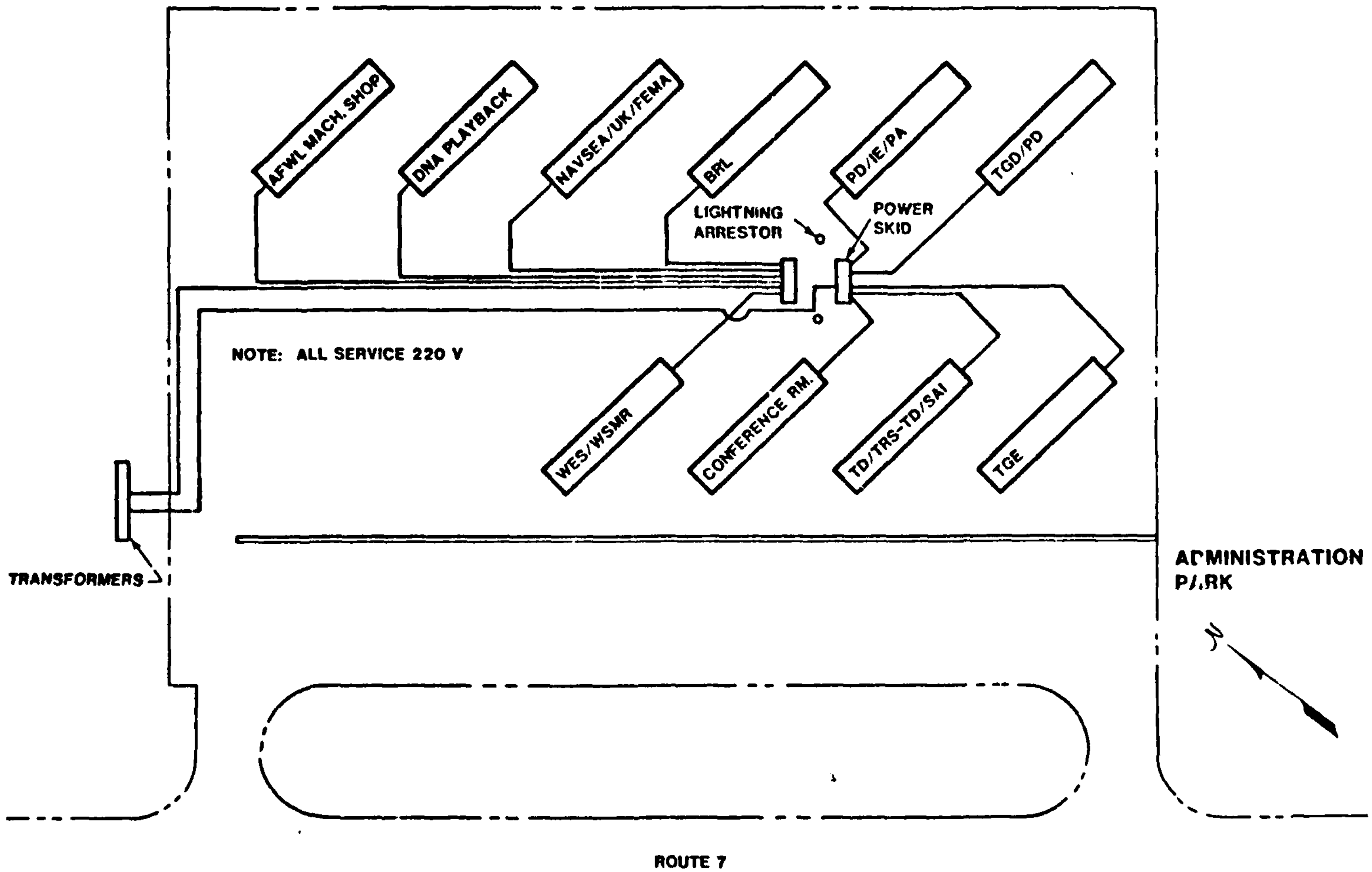


Figure 3-25. MILL RACE Administration Park.

Table 3-8. MILL RACE instrumentation trailers, recording agency, and data channels.

Trailer No./Recording Agency	DNA Experiment No.	No. of Data Channels
North Instrumentation Park		
N2/AFWL	4001/4002/4003	46
	4101	10
	4401	9
N3/DNA-SAI	9102	11
N4/BRL	2053/2054/2055 2056/2058	10
	2071	100
	8101/8102	2
	8111	2
	8501/8502	2
	9103	2
	9901	54
N5/WES	9001	126
South Instrumentation Park		
S1/FEMA-SAI-SSI	5001/5002/5003	5
	5101	3
	5201	6
	5301	1
S2/NAVY-SSS-SRII	3007	78
	9406/9407	12
S3/FEMA-SRII	5401/5402/5403	38
	9401	12
S4/BRL	2007/2008	35
	2012	33
	2081	31
	9901	46
	9902	6
	9909	12
S6/WSMR	2301/2302/2303/2305	38
	2311	37
S7/WES	2601/2602	56
	7001	12

instrumentation trailers, between test control and the T&F trailer, and between test control and the WSMR Range Net.

3-10 VIDEO SYSTEM.

There were two video systems used on shot day; one was used to monitor drone and testbed operations and one to monitor the TRS operation. The first system used four cameras covering the takeoff of the drones, the intercept of the airblast shockwave and the drones, the MILL RACE stacked charge, and the TRS at the 3.5 (24.1 kPa) psi level. All views from these locations were transmitted via microwave to the Observation Point (OP) above Miller's Watch, WSMR. Approximately 400 people observed the execution of MILL RACE from the OP.

The TRS video system used two front-viewing cameras with one camera viewing the UK Navy TRS at the 3.5 psi (24.1 kPa) level and one camera viewing the three separate TRS pits at the 7.5 psi (51.7 kPa) level. Signals were fed to the TRS trailer (S1) in the South Instrumentation Park through fiber optics cables. The purpose of the TRS video was to ensure the oxygen propane burners were lit, to monitor their operation, and to provide a documentary record of the event.

3-11 TECHNICAL PHOTOGRAPHY.

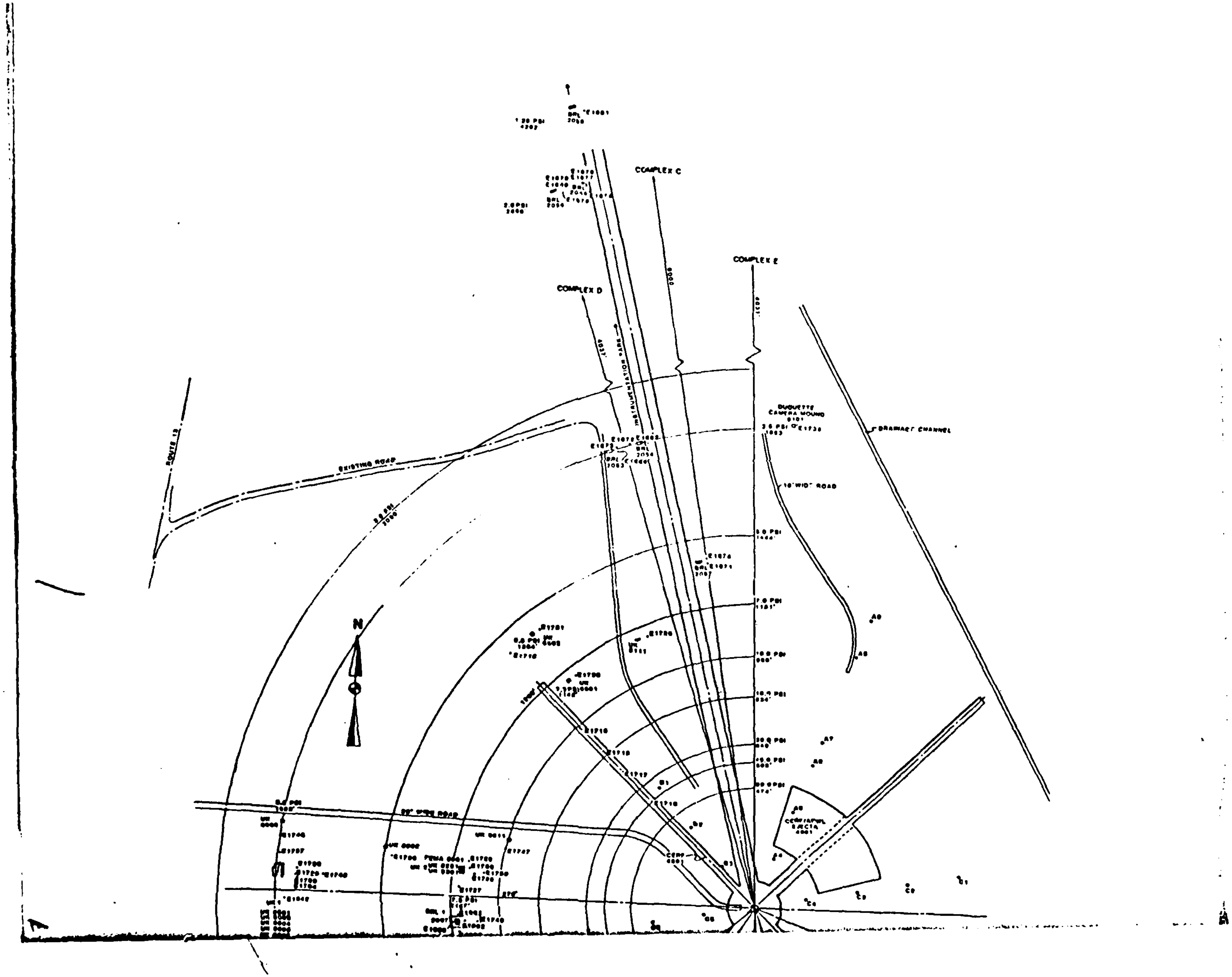
The objective of technical photography was to generate a visual record of an experiment or part of an experiment in order to conduct analytical reviews or make analytical calculations on the effects of the blast and/or thermal radiation. A total of 117 cameras were fielded for MILL RACE technical photography. Table 3-9 gives the agencies fielding cameras and number of cameras fielded.

Table 3-9. Agencies providing technical camera coverage.

Agency	Quantity	Experiment Coverage
WSMR (Dynalectron)	99	All experiments with cameras except as noted below
SNLA	10	2075 - Generic Mobile Radars
SAI/TBE	6	9101 - Dust Layer Studies
TIC	2	9191 - Dust Cloud Phenomenology

Figure 3-26 shows the WSMR-fielded technical photography layout. A design drawing of each experiment covered by WSMR photography is given in Figures 3-27 through 3-63. Table 3-10 lists the cameras which provided the technical photography and provides specific information for each camera.

All testbed cameras were housed in a protective box mounted on a rigid pedestal. Start signals were received by cable from the T&F trailer. Zero time was indicated by first light on the film, a FIDU signal, or from an IRIG timing mark. All cameras had some sort of local oscillator timing marks on the film to determine frame rate.



COMPLEX C
COMPLEX D
COMPLEX E
DUQUETTE CAMERA MOUND
DRAINAGE CHANNEL
10' WIDE ROAD
EXISTING ROAD
ROUTE 13
INSTRUMENTATION PARK
CENTRAL EJECTA
N

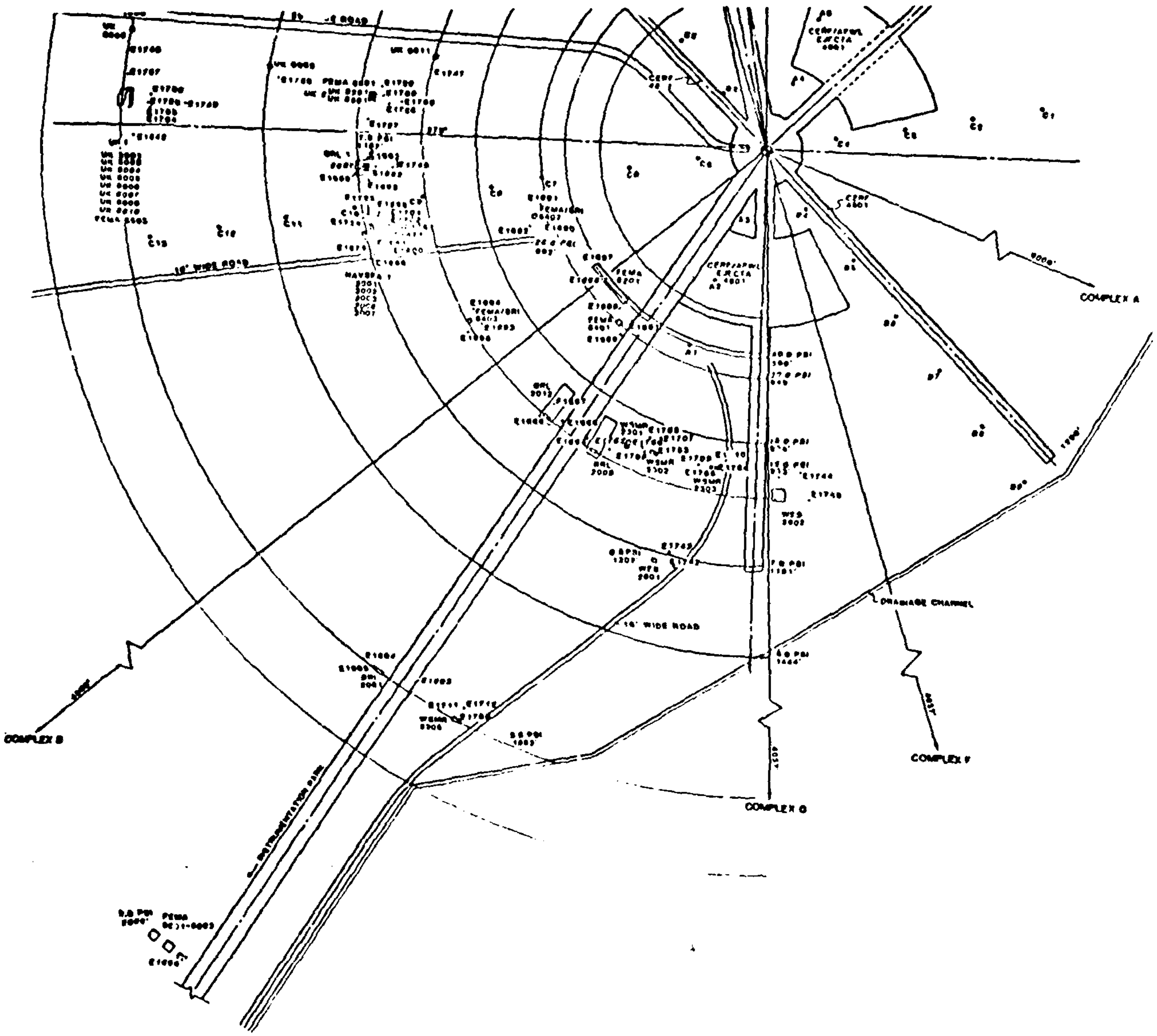


Figure 3-26. MILL RACE technical photography layout.

2

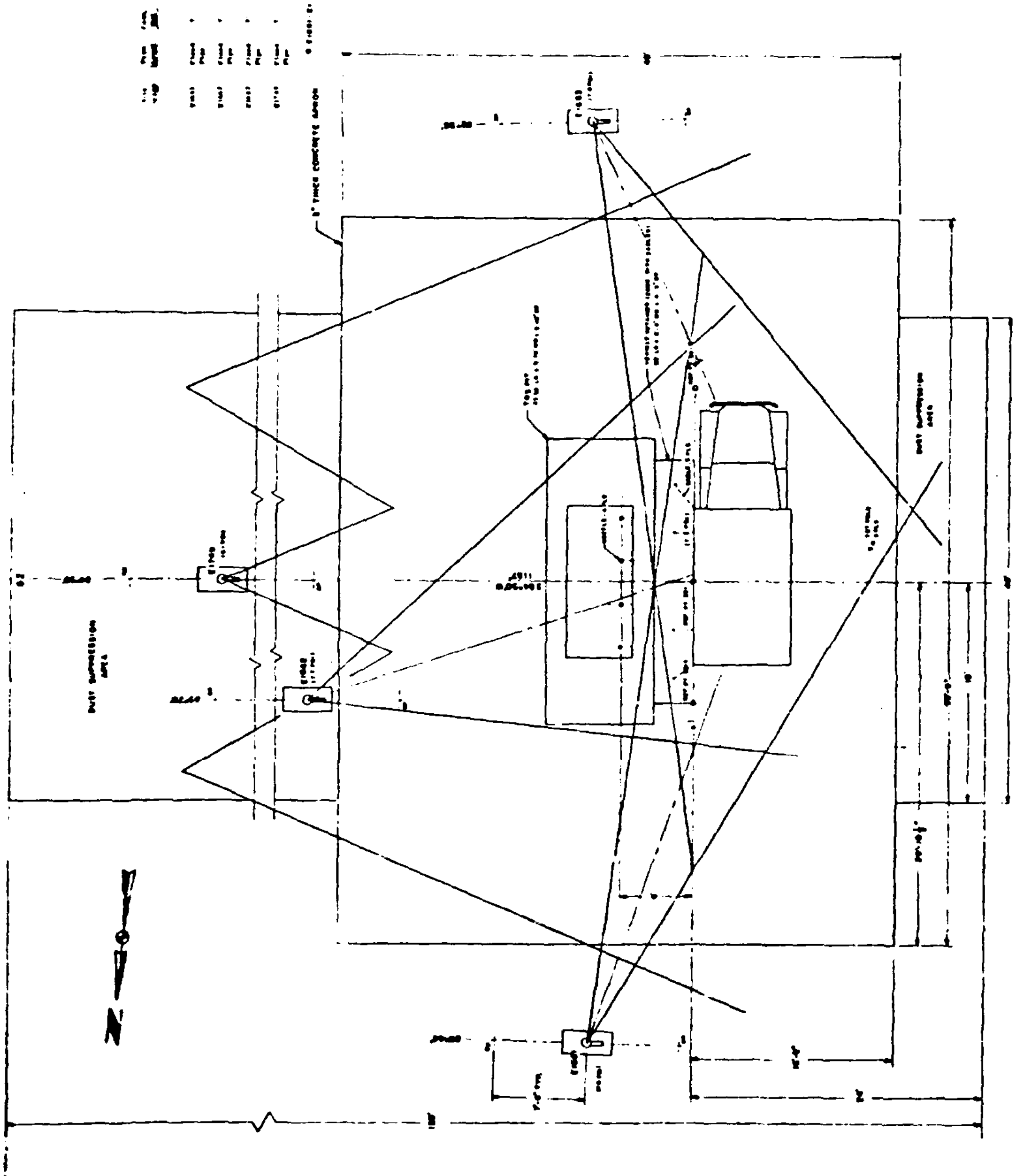


Figure 3-27. Camera coverage of experiment 2007.

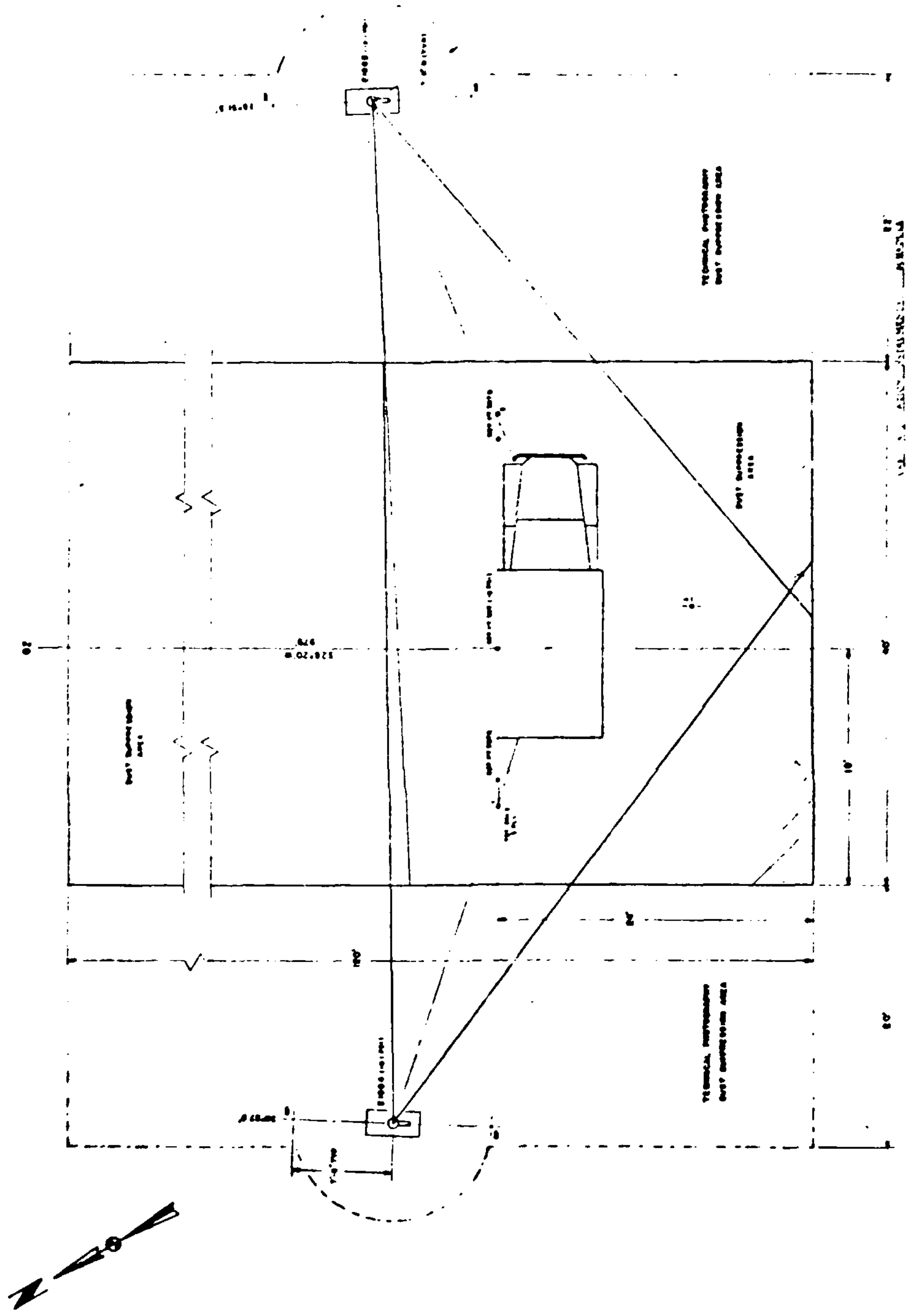


Figure 3-20. Camera coverage of experiment 2008.

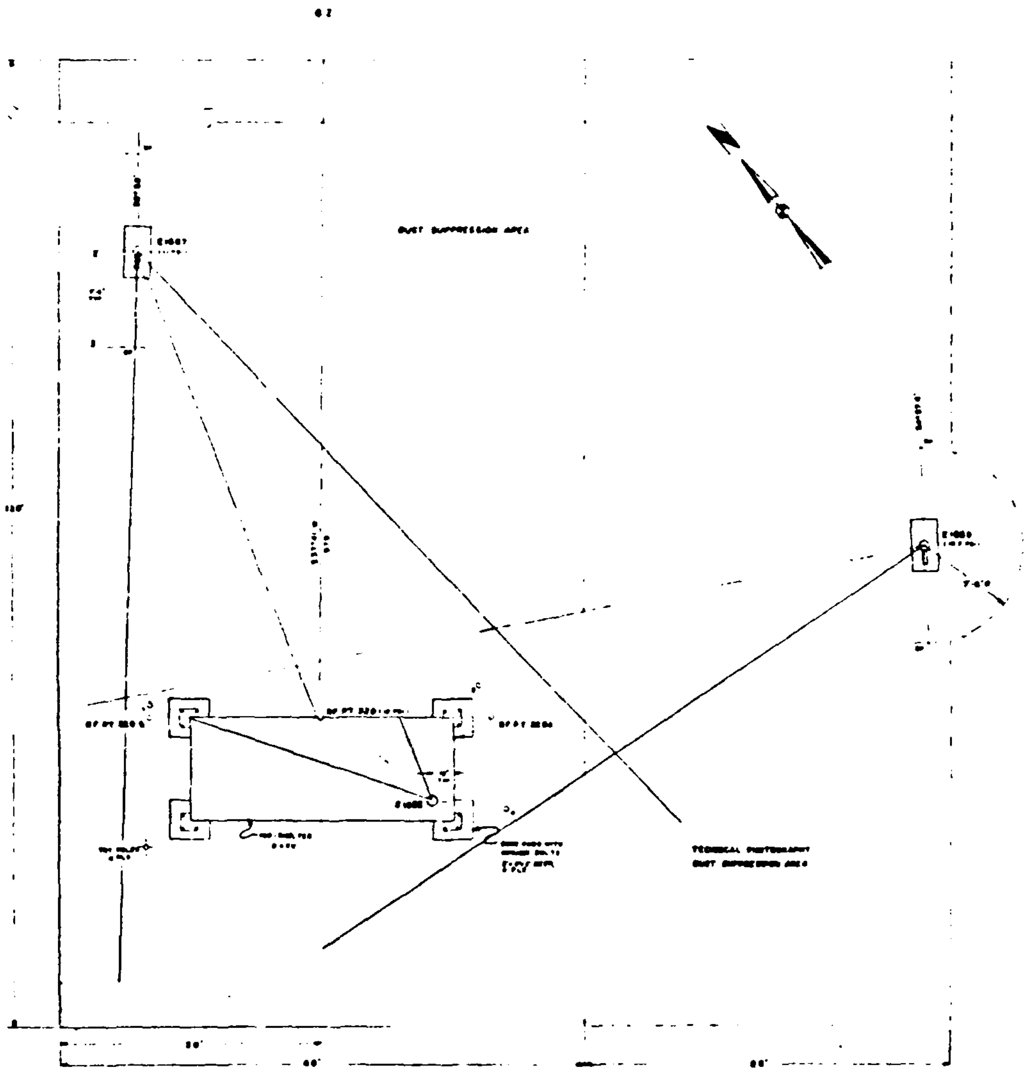


Figure 3-29. Camera coverage of experiment 2012.

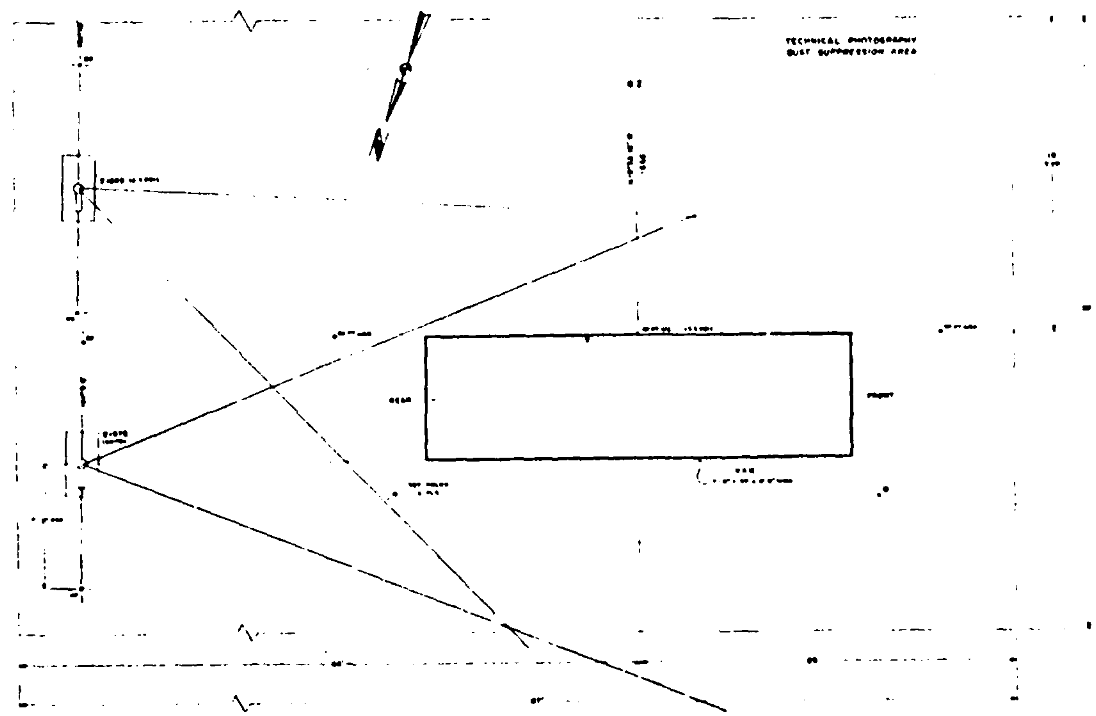


Figure 3-30. Camera coverage of experiment 2053.

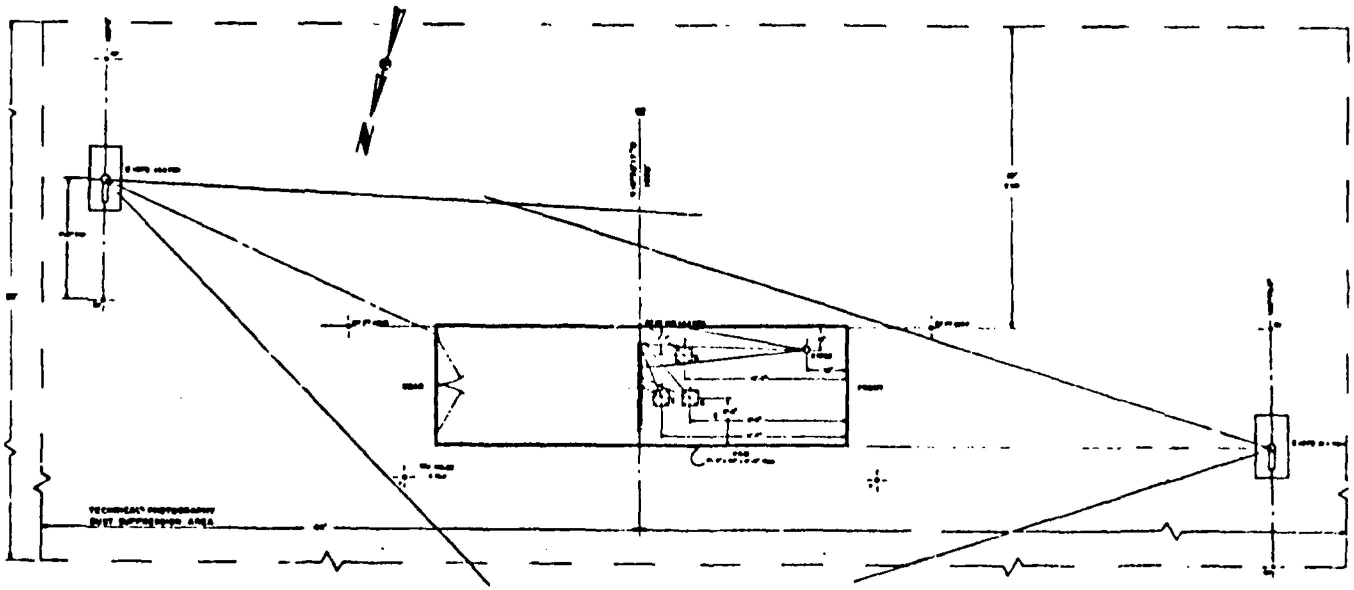


Figure 3-31. Camera coverage of experiment 2054.

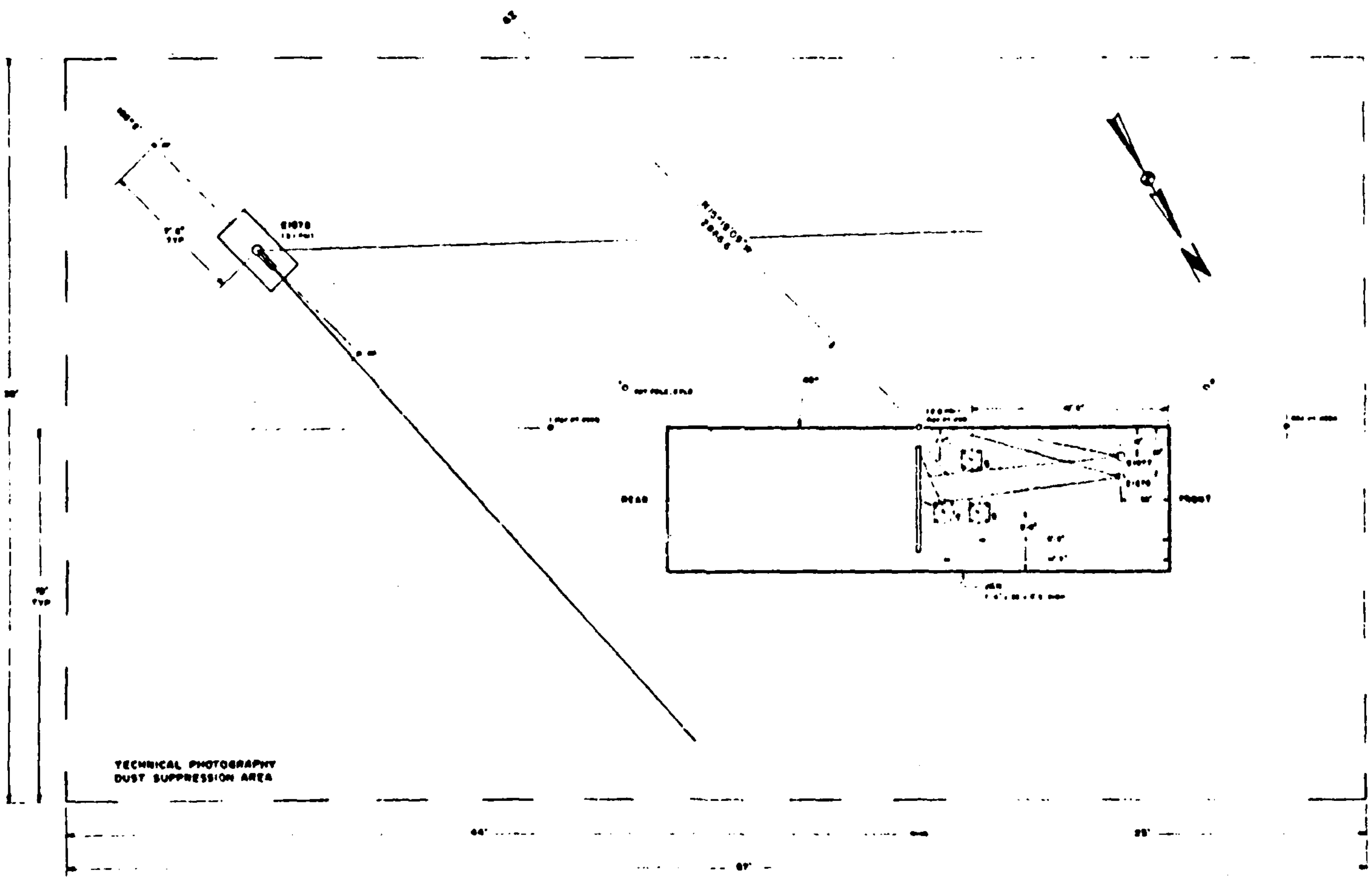


Figure 3-32. Camera coverage of experiment 2055.

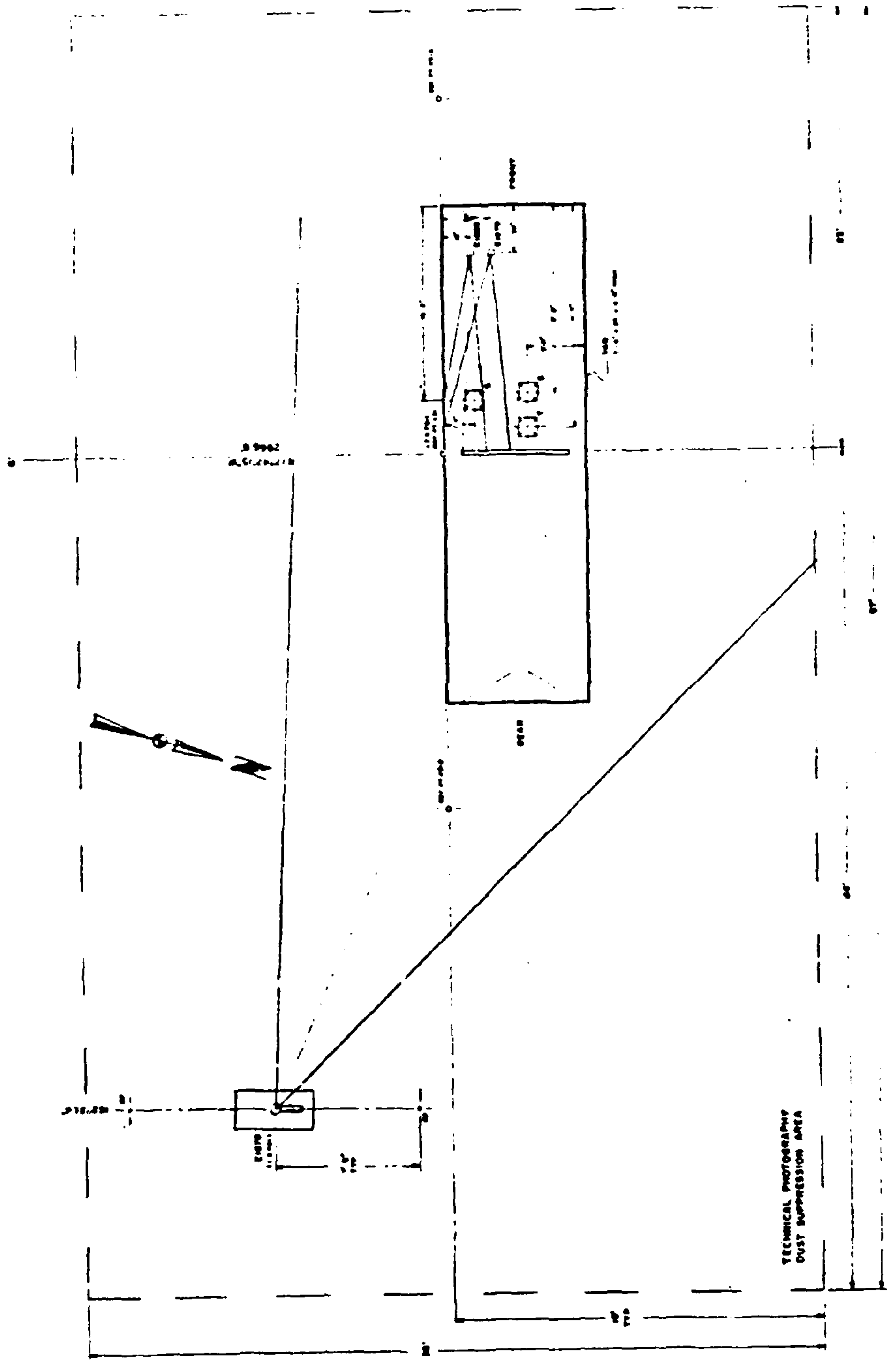


Figure 3-33. Camera coverage of experiment 2056.

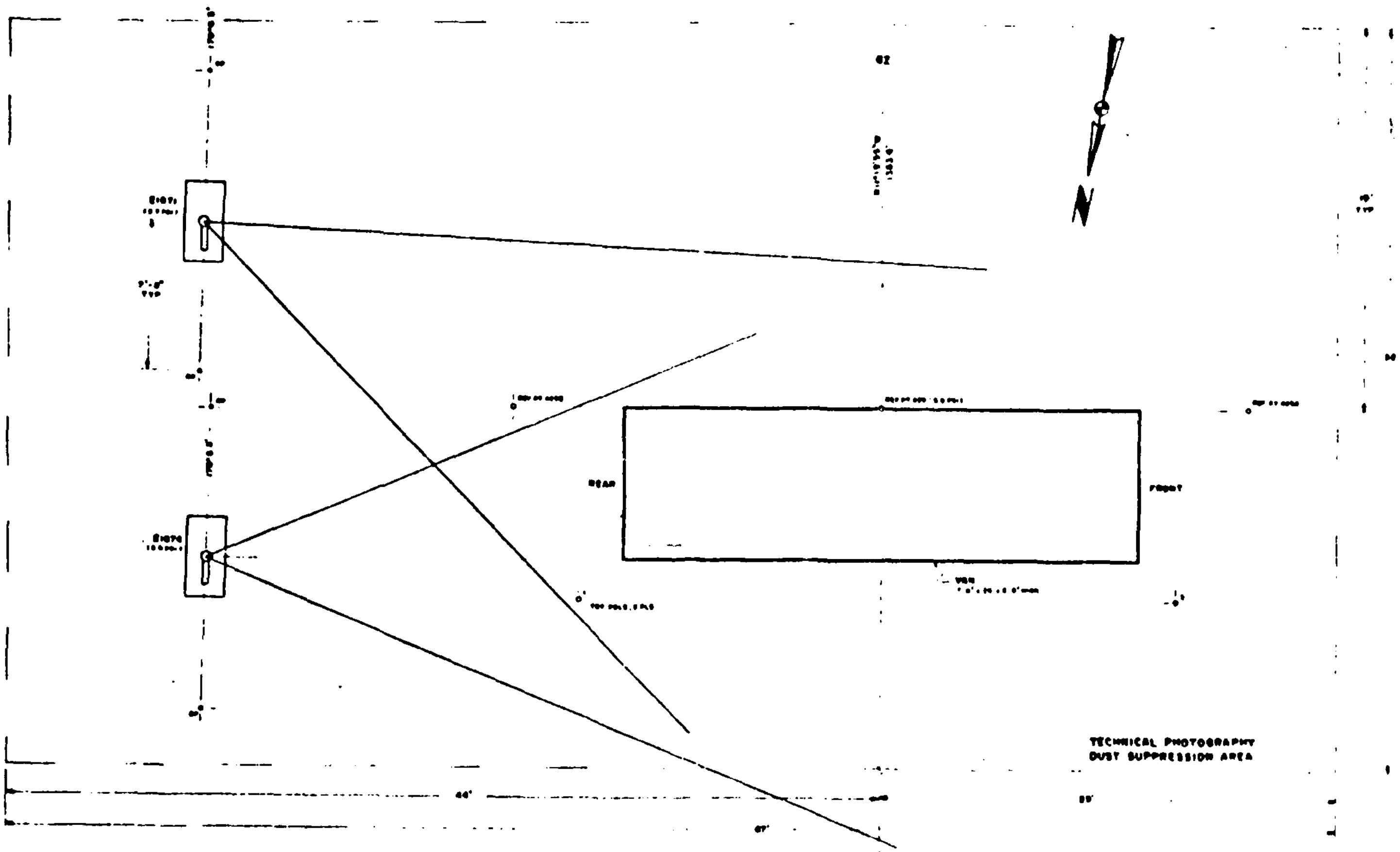


Figure 3-34. Camera coverage of experiment 2057.

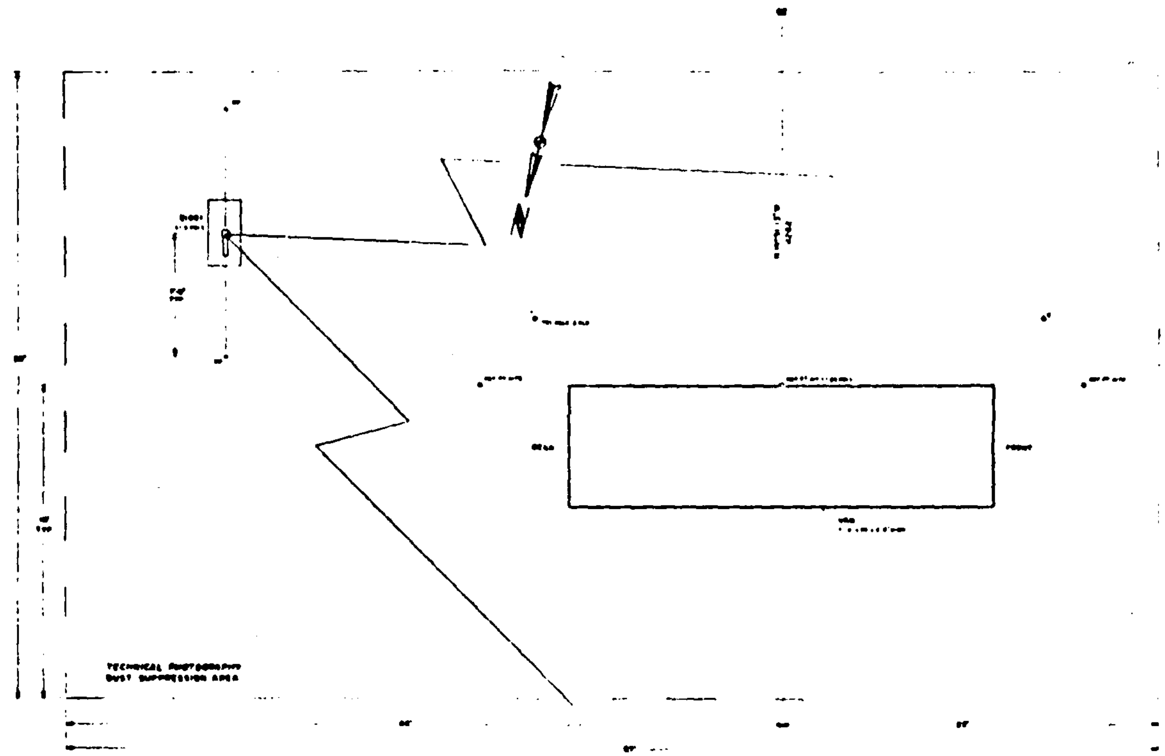


Figure 3-35. Camera coverage of experiment 2058.

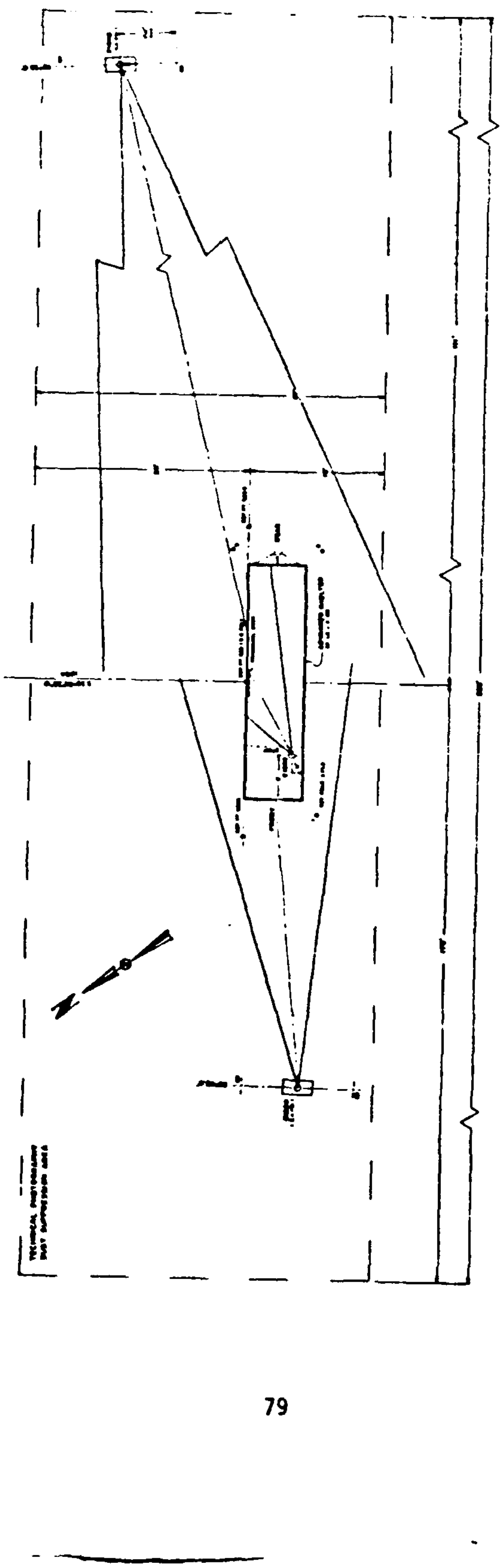


Figure 3-36. Camera coverage of experiment 2081.

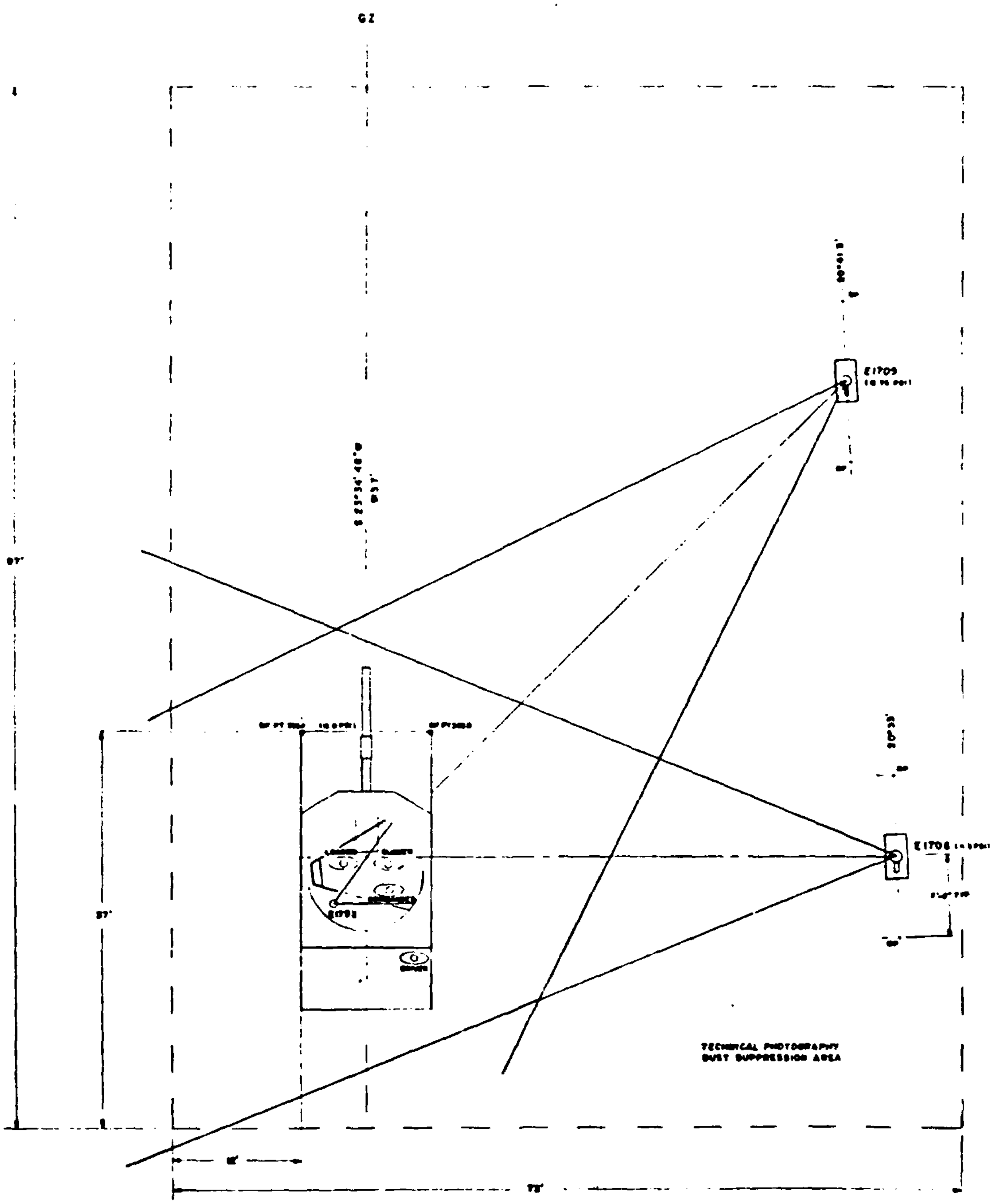


Figure 3-37. Camera coverage of experiments 2301/2311.

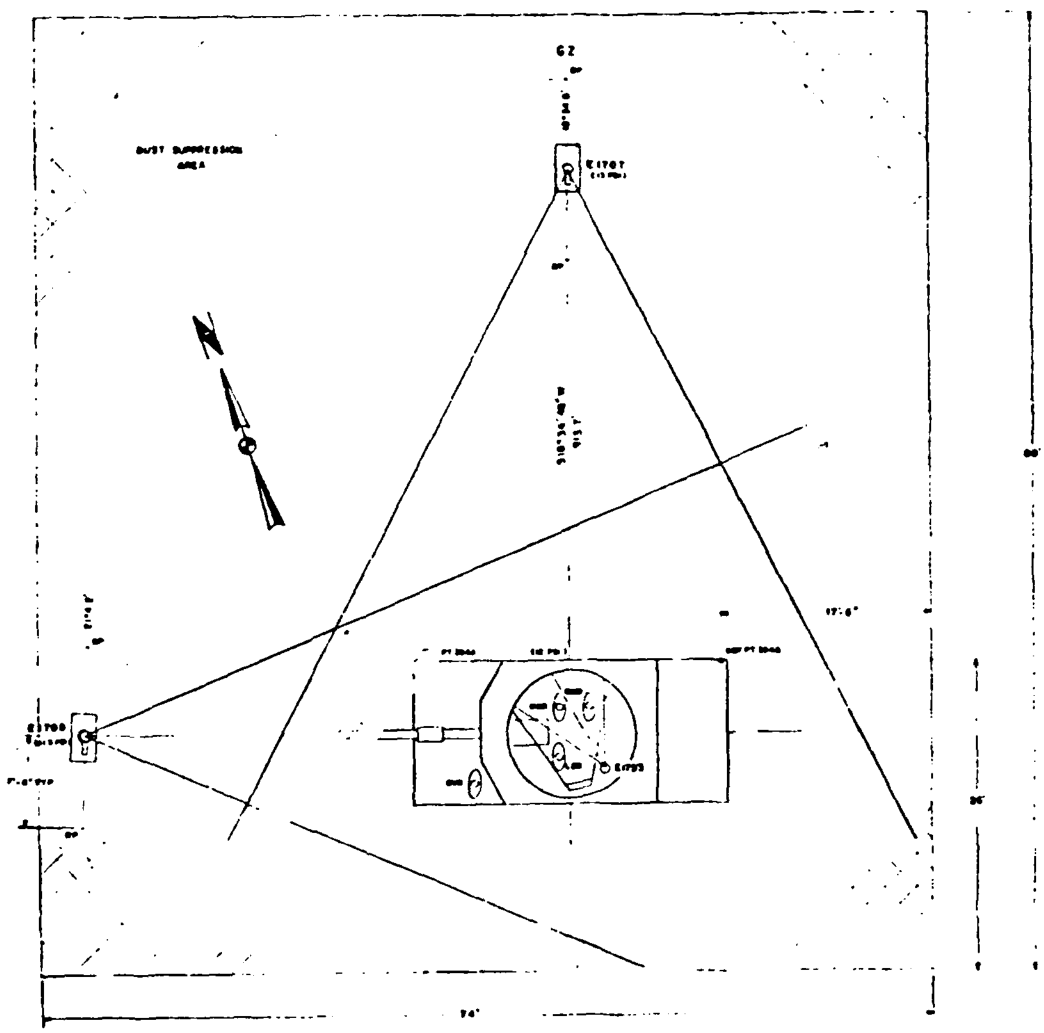


Figure 3-38. Camera coverage of experiments 2302 and 2311.

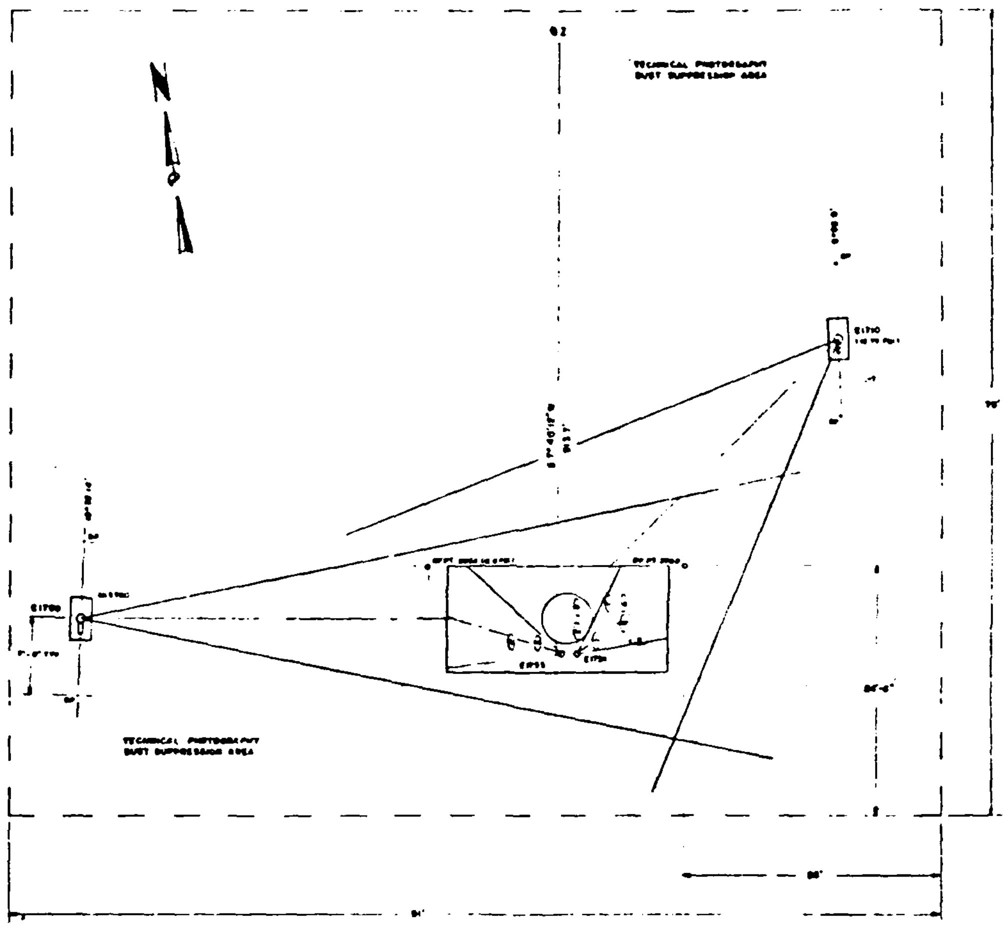


Figure 3-39. Camera coverage of experiments 2303 and 2311.

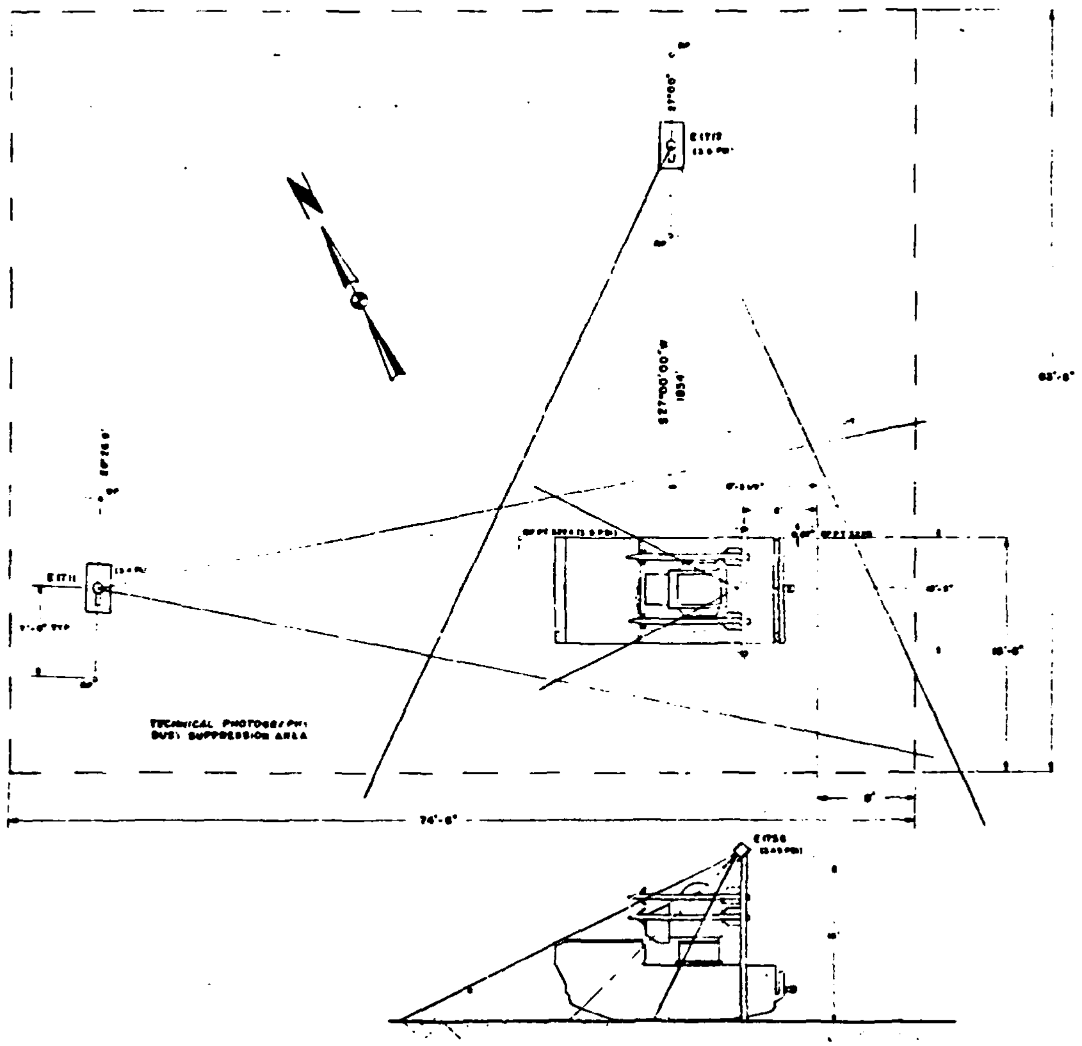


Figure 3-40. Camera coverage of experiment 2305.

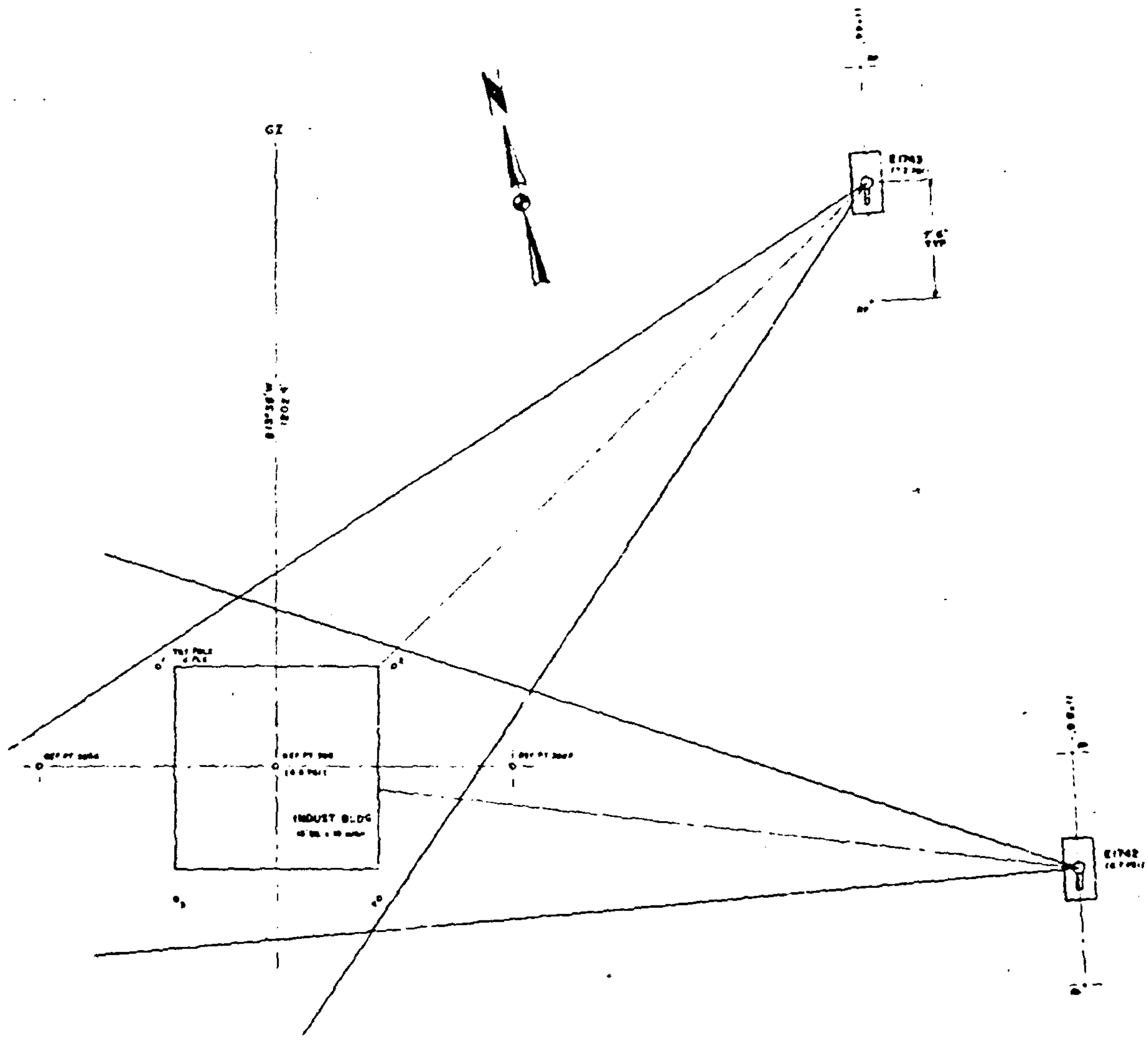


Figure 3-41. Camera coverage of experiment 2601.

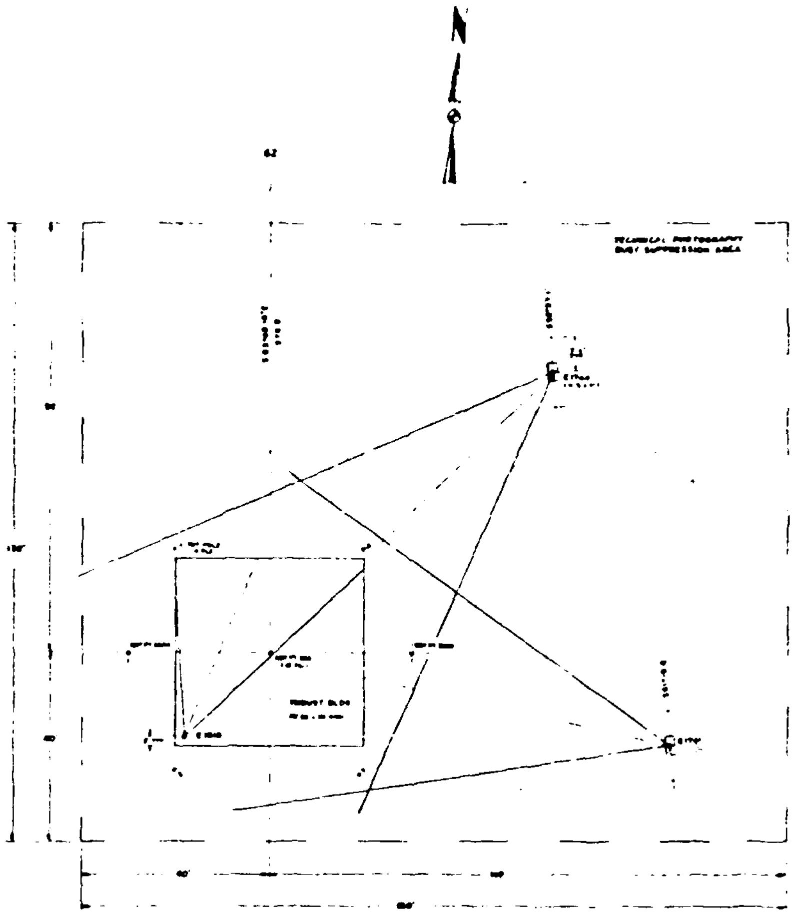


Figure 3-42. Camera coverage of experiment 2602.

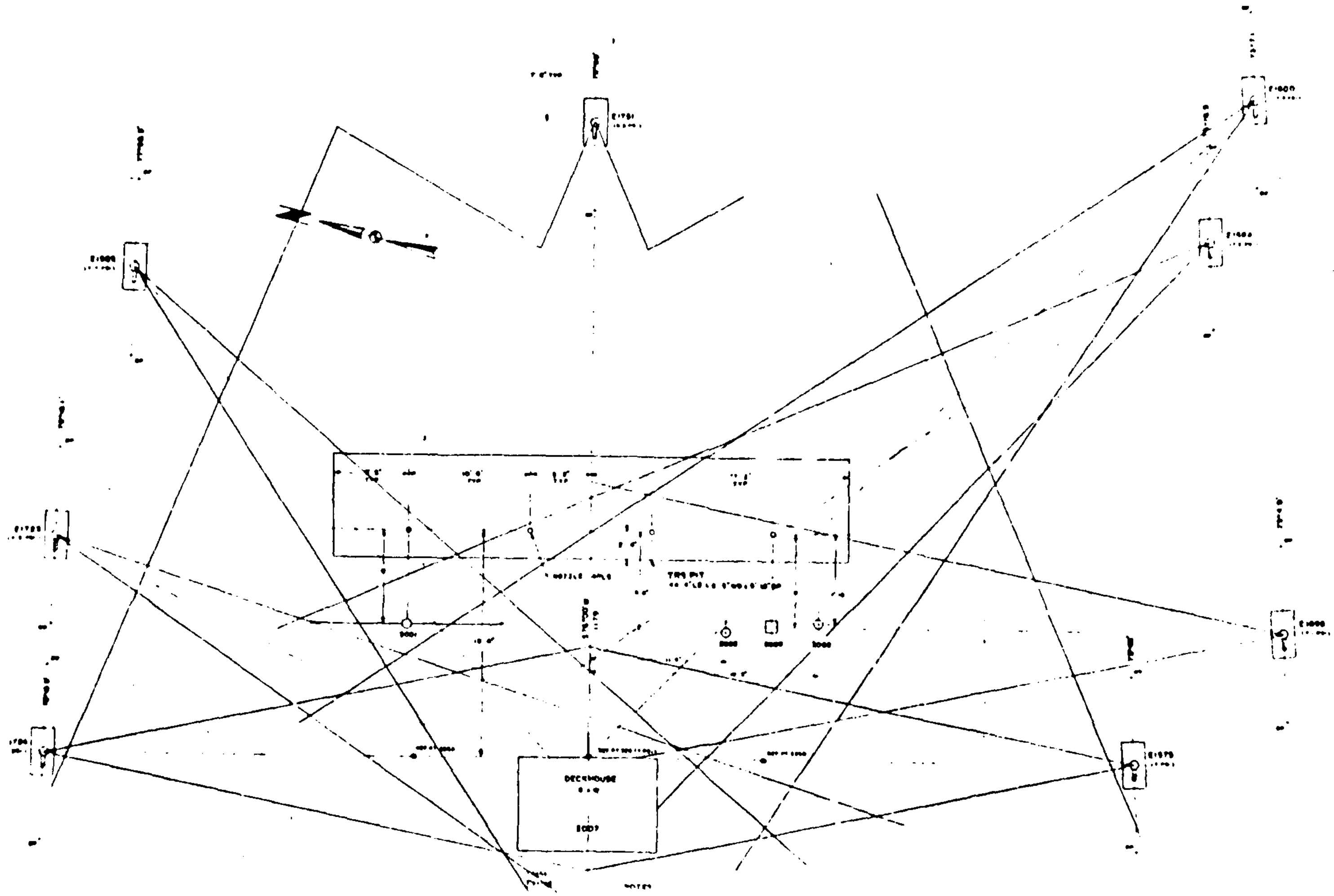


Figure 3-43. Camera coverage of experiments 3001, 2, 3, 5, and 7.

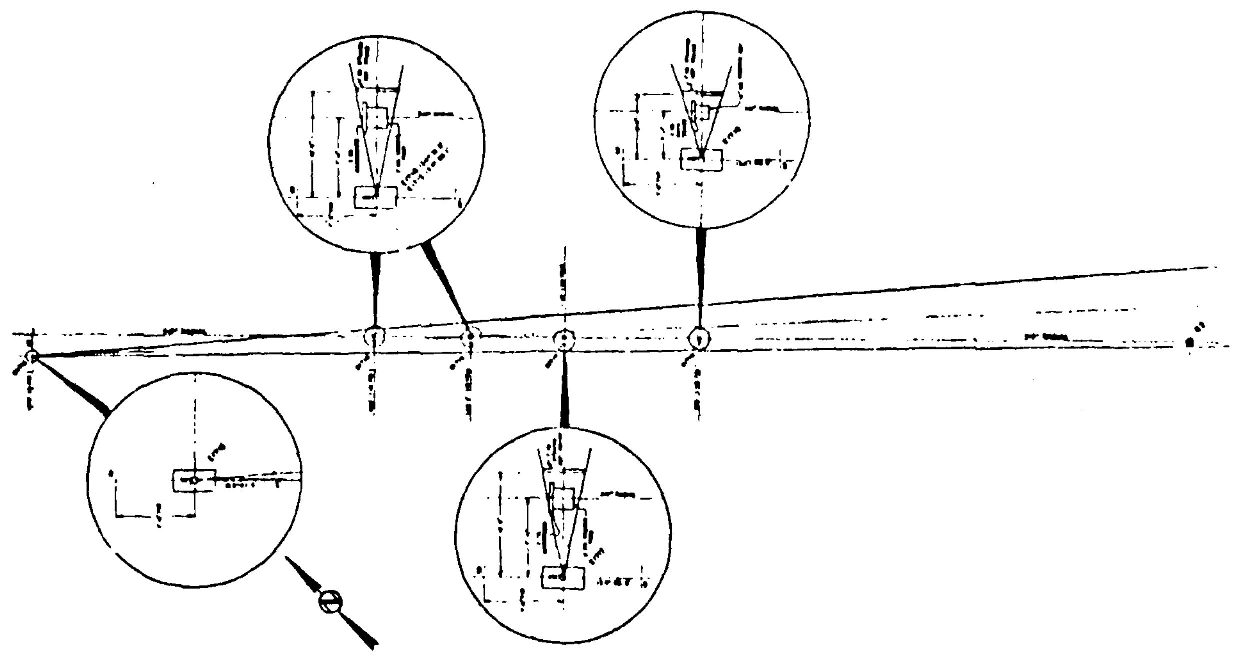


Figure 3-44. Camera coverage of experiment 4501.

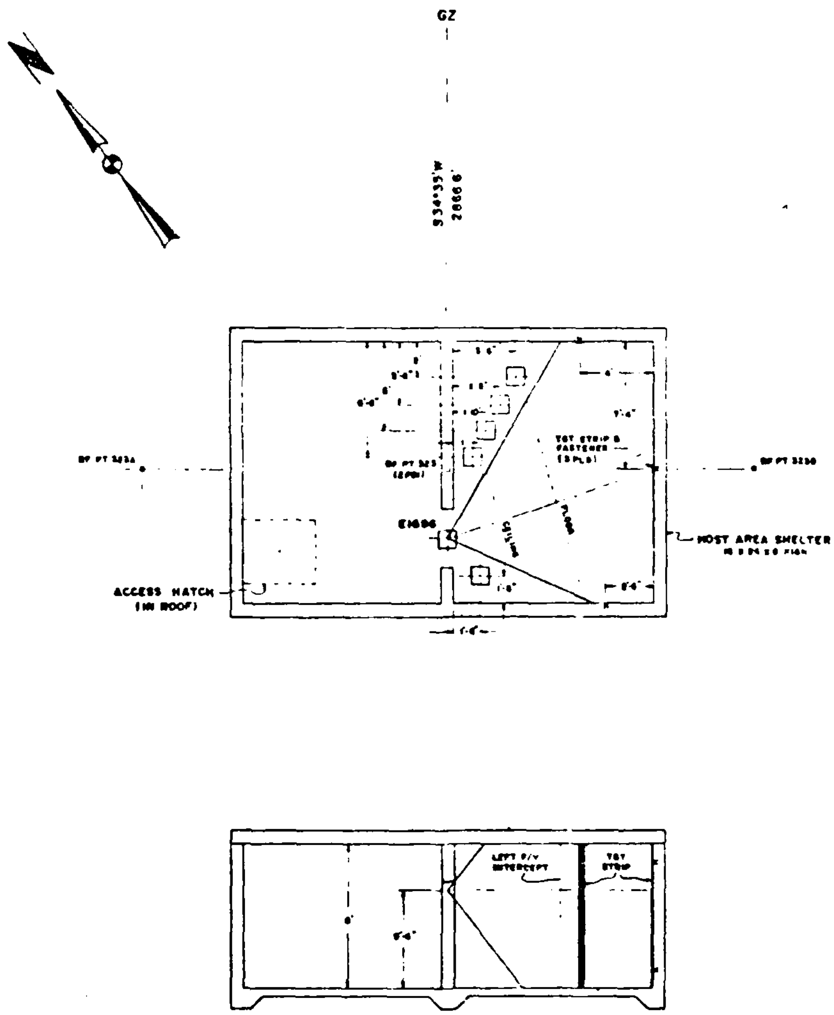


Figure 3-45. Camera coverage of experiment 5003.

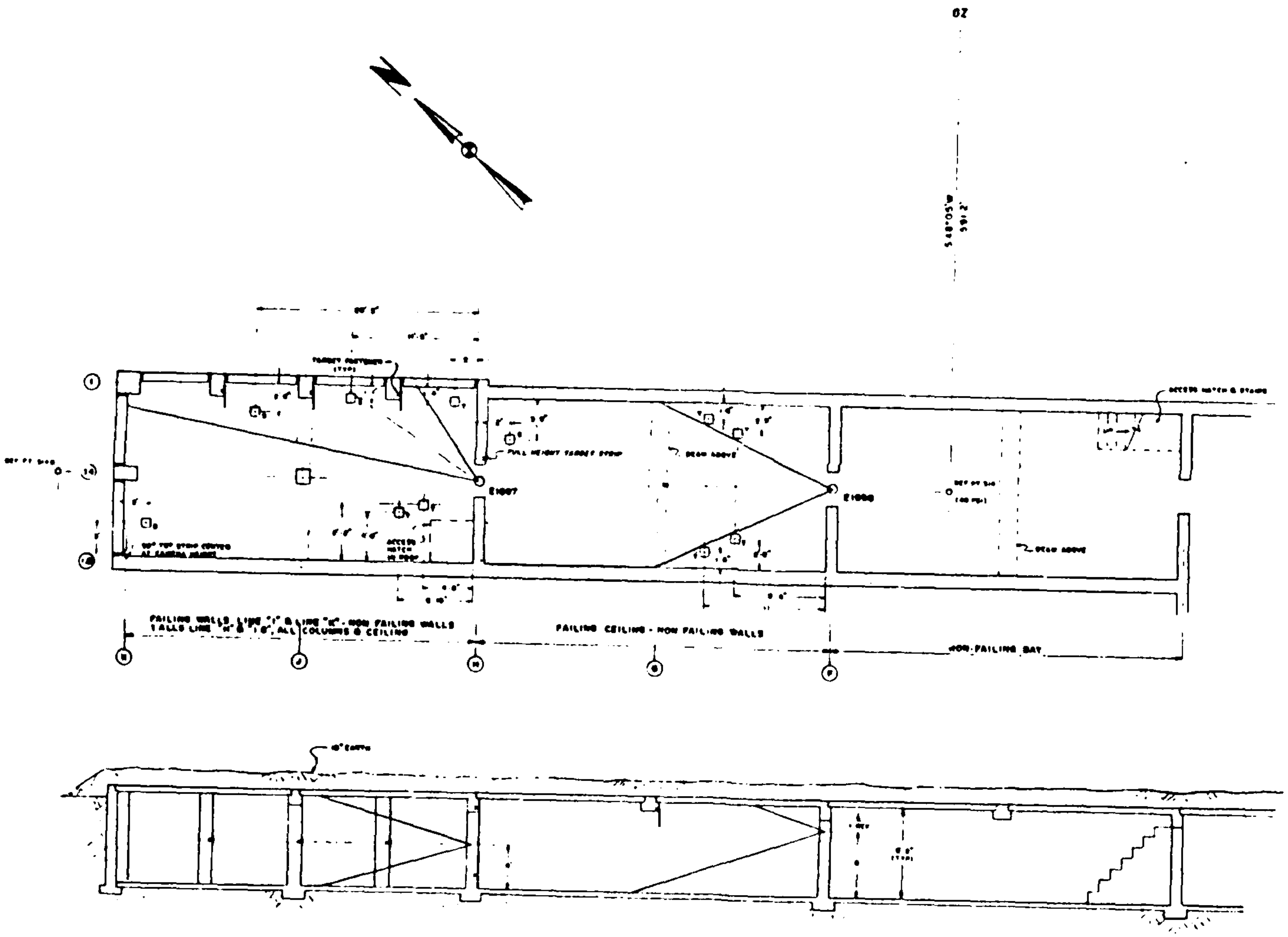


Figure 3-46. Camera coverage of experiment 5201.

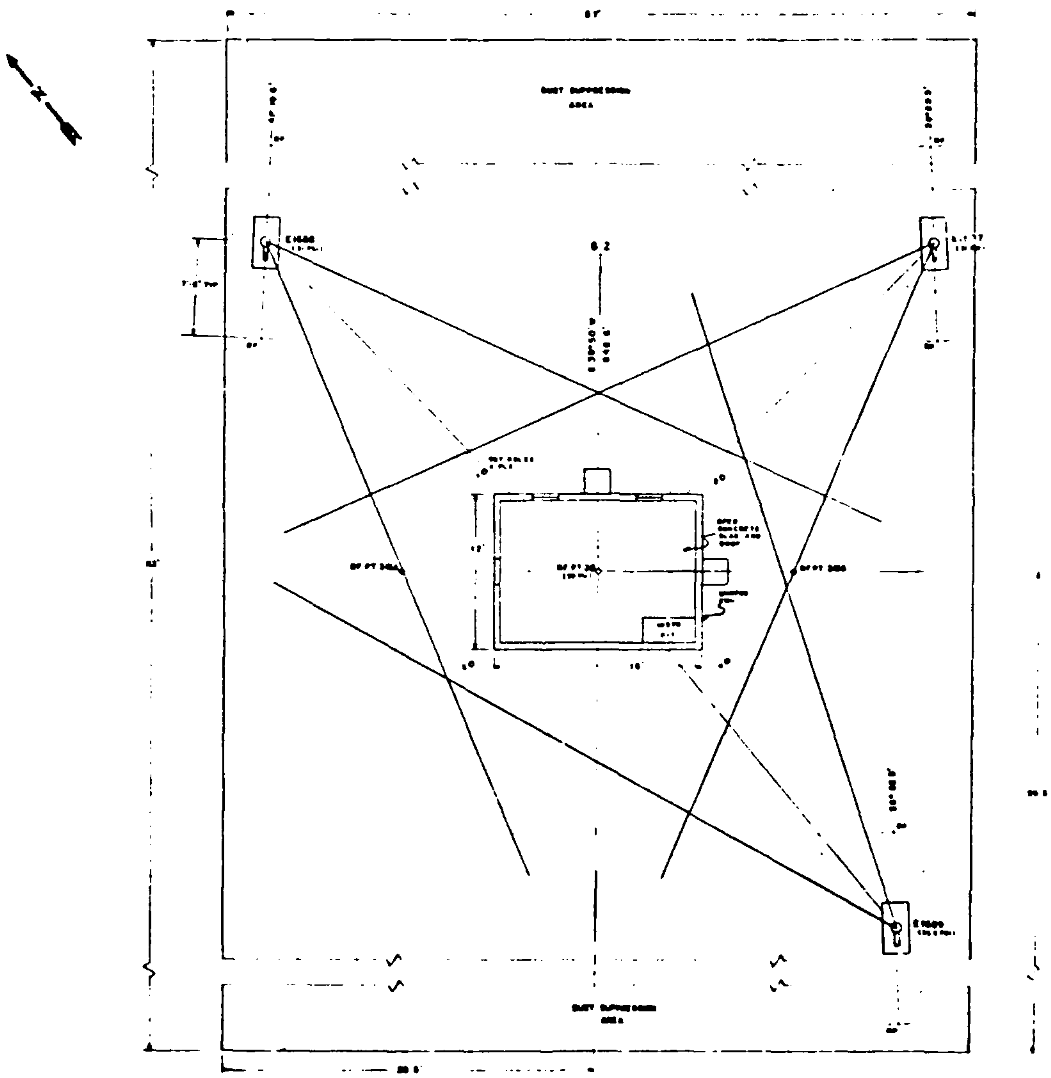


Figure 3-47. Camera coverage of experiment 5401.

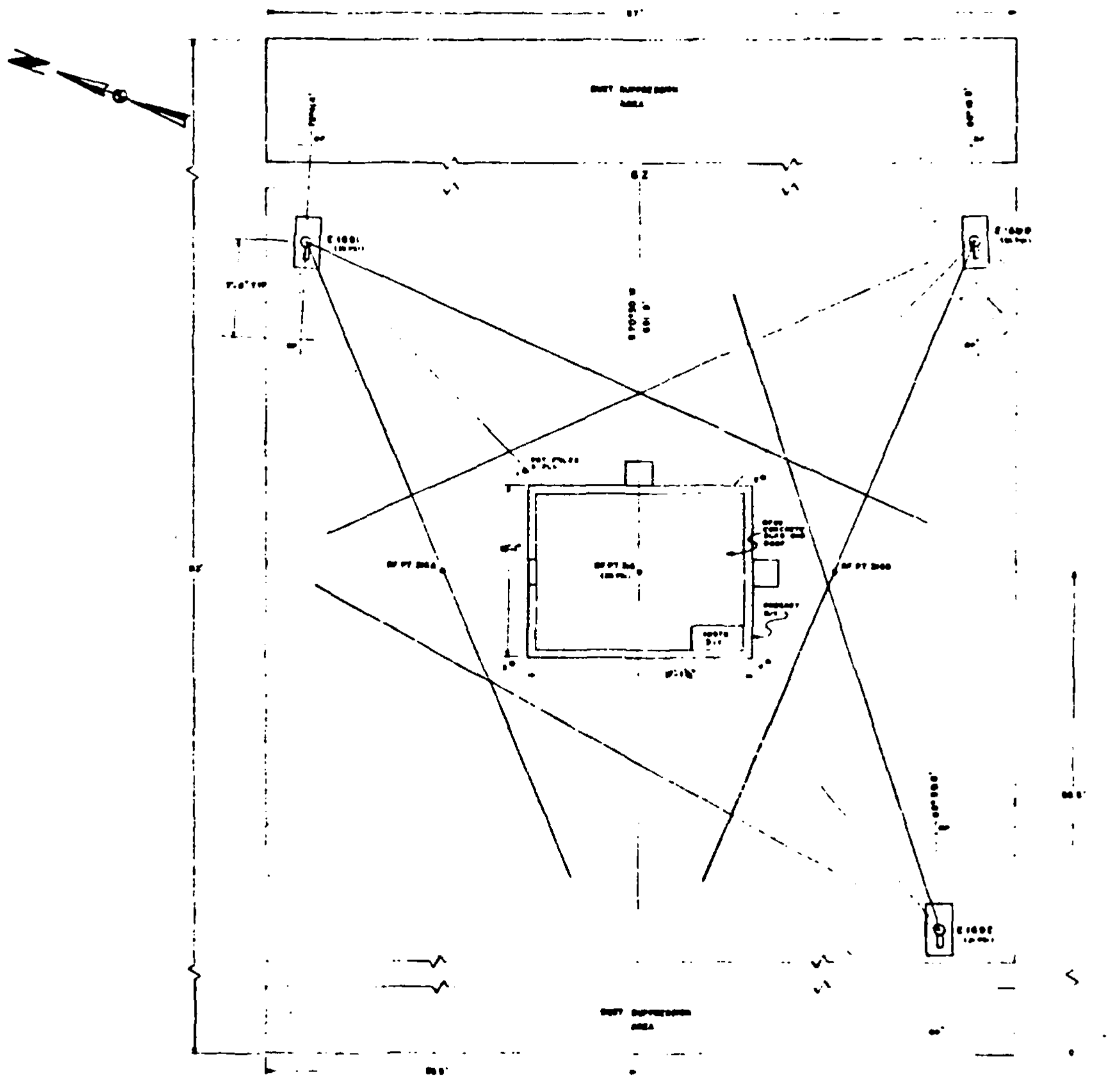


Figure 3-48. Camera coverage of experiment 5402.

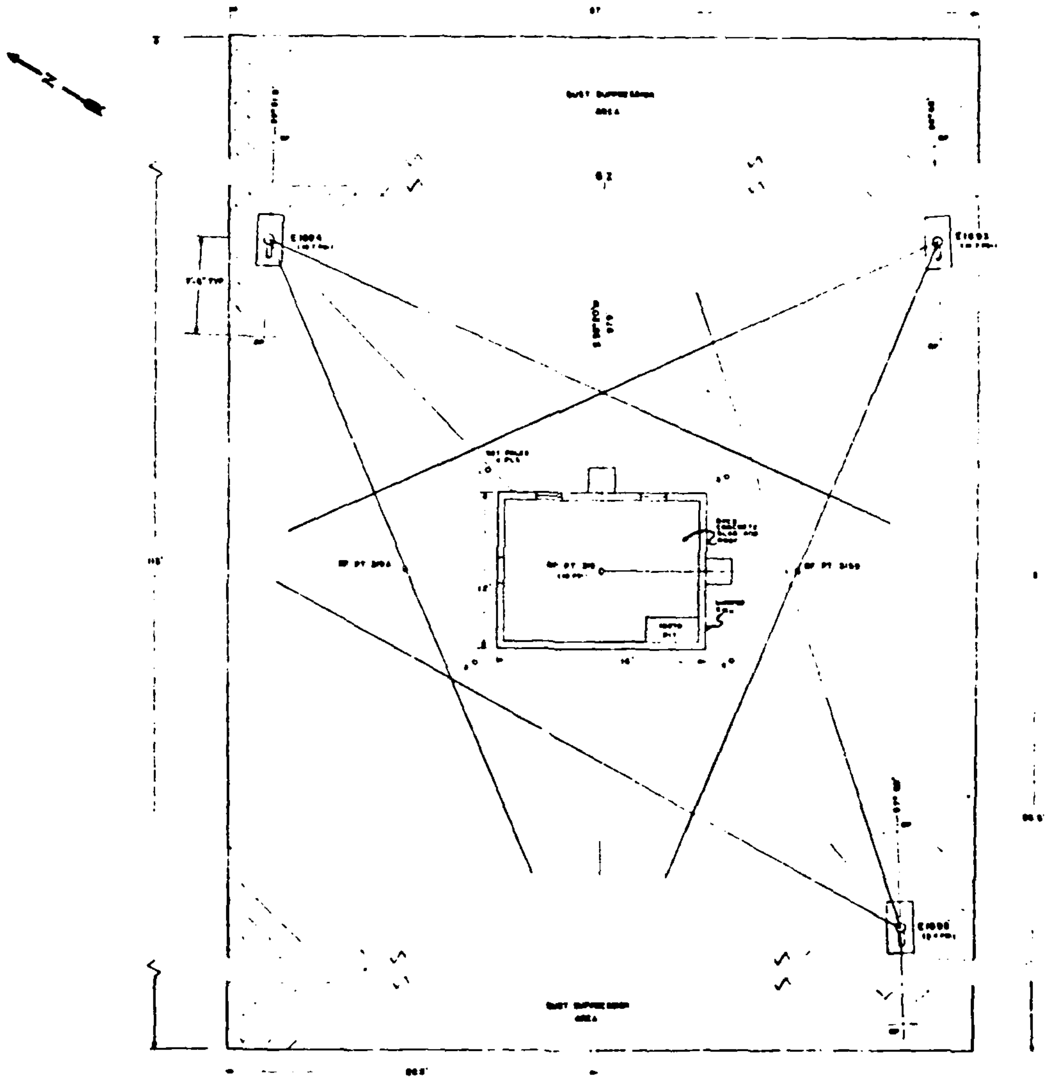


Figure 3-49. Camera coverage of experiment 5403.

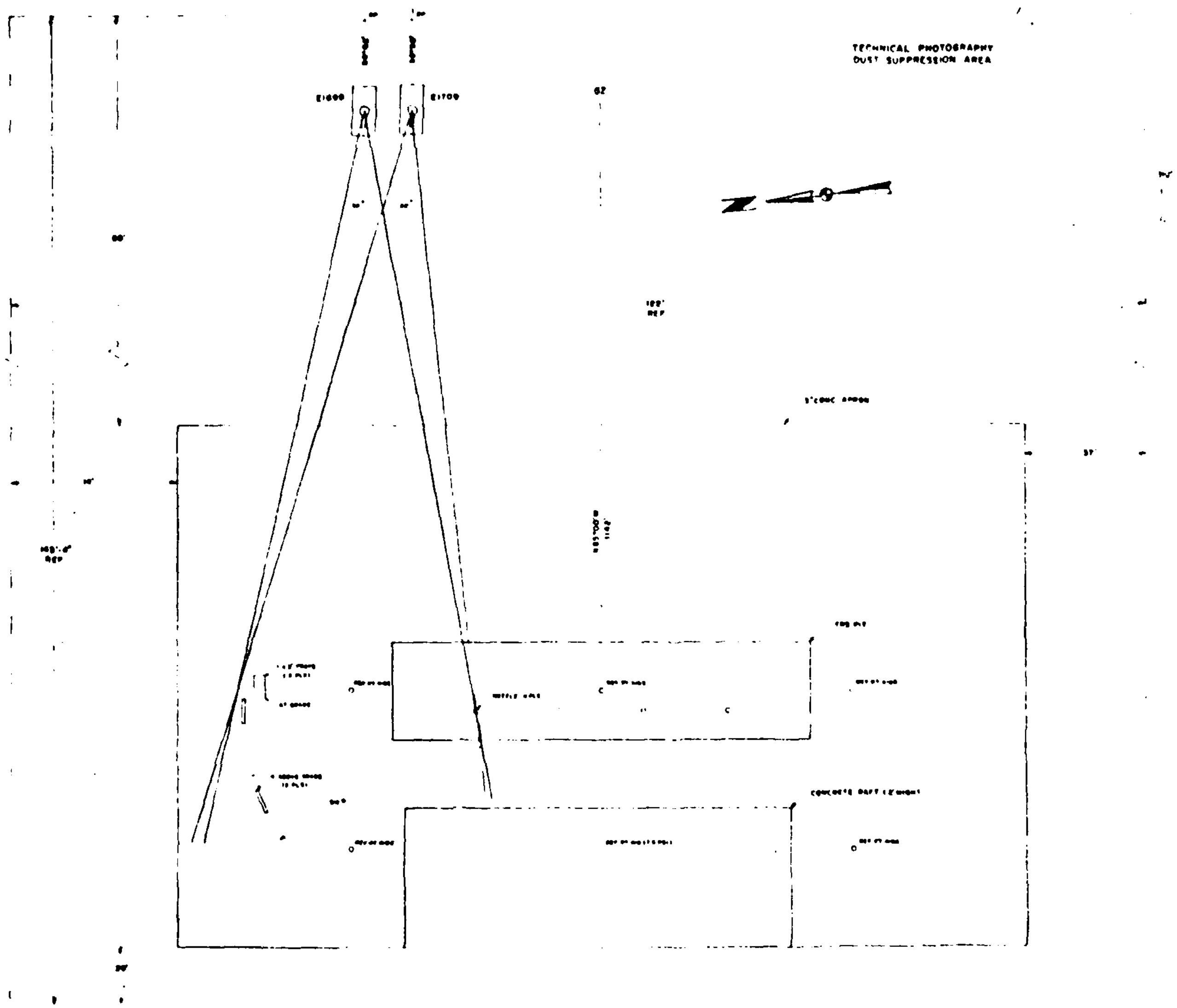


Figure 3-50. Camera coverage of experiment 5501.

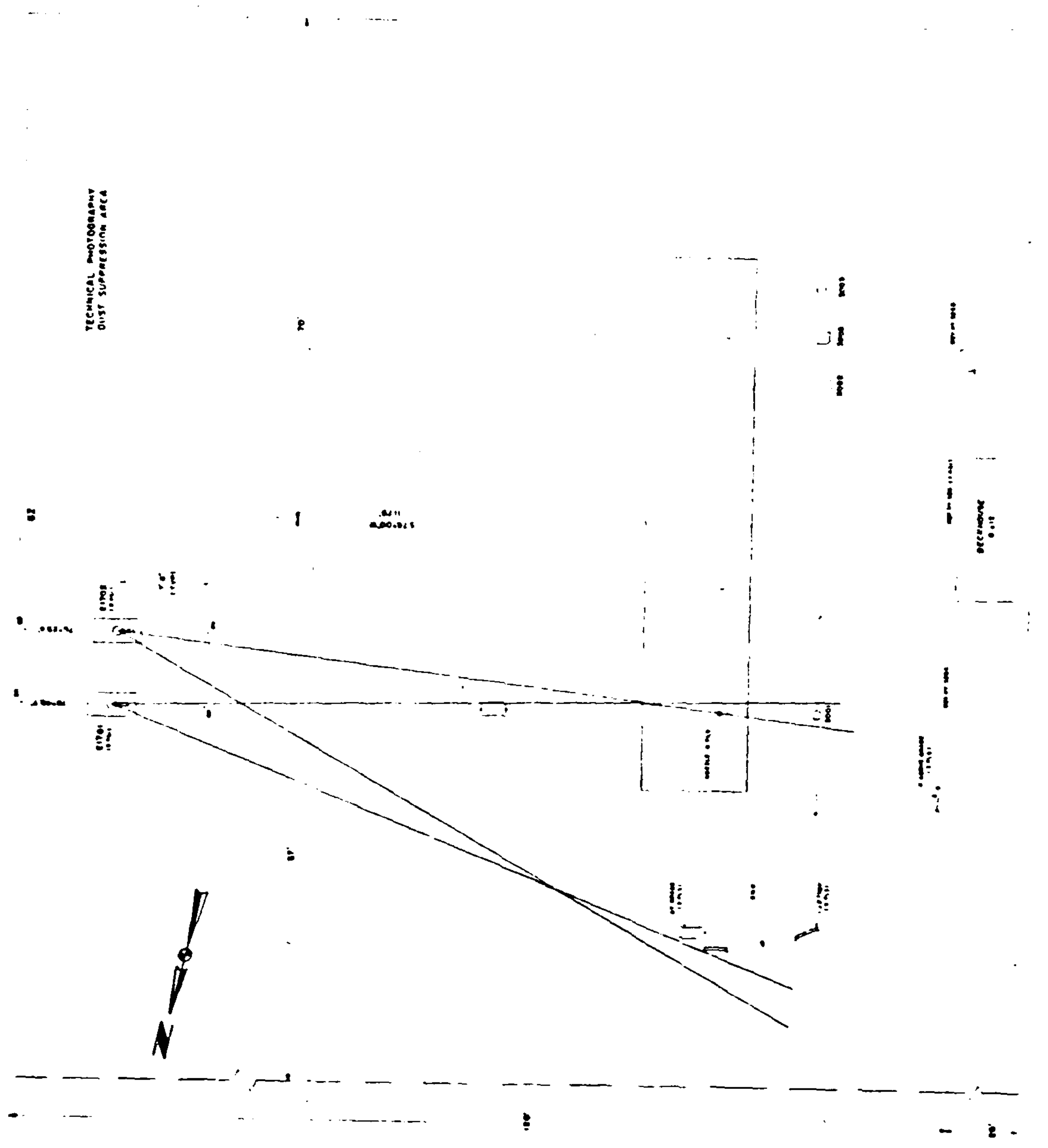


Figure 3-51. Camera coverage of experiment 5502.

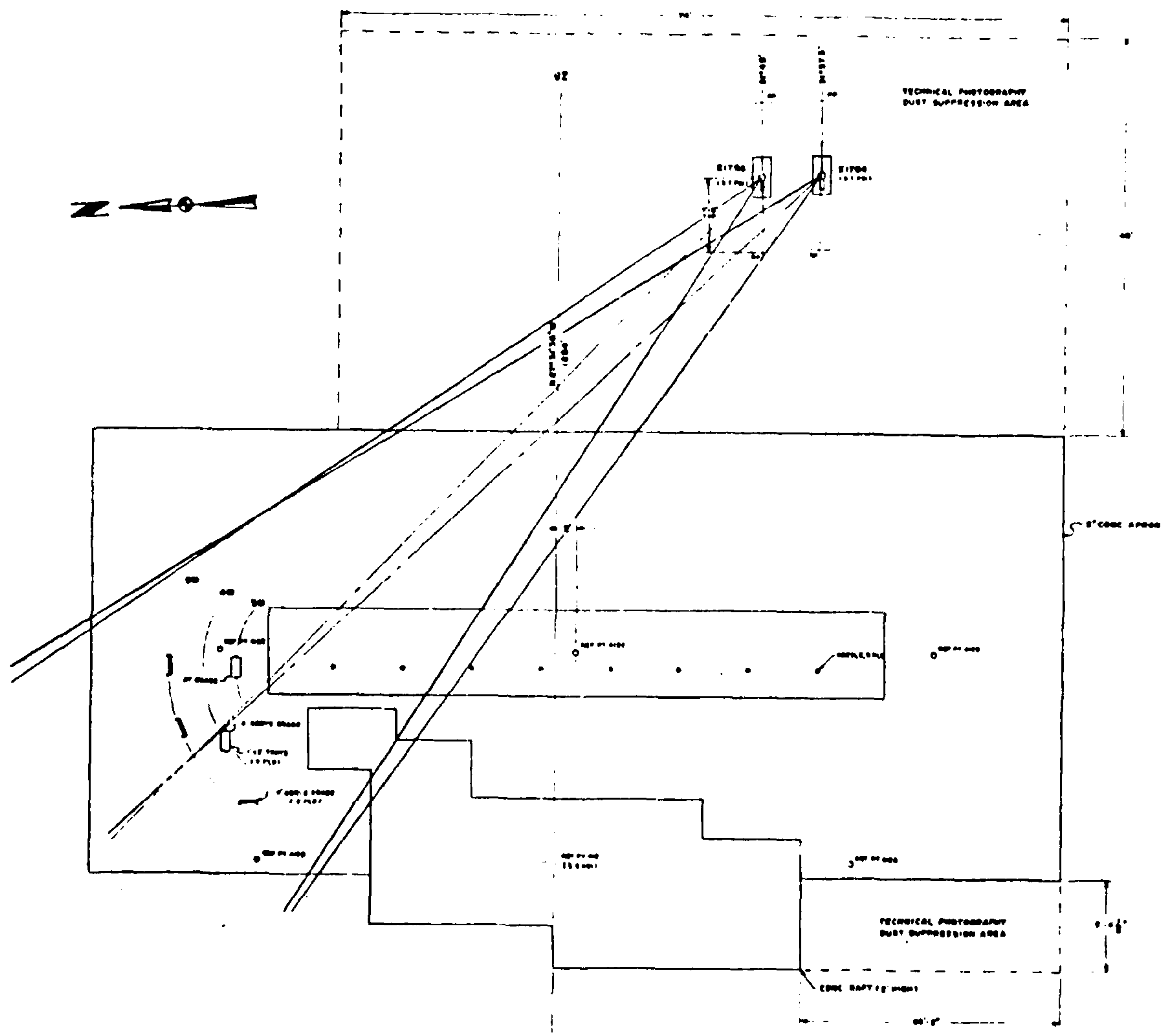


Figure 3-52. Camera coverage of experiment 5503.

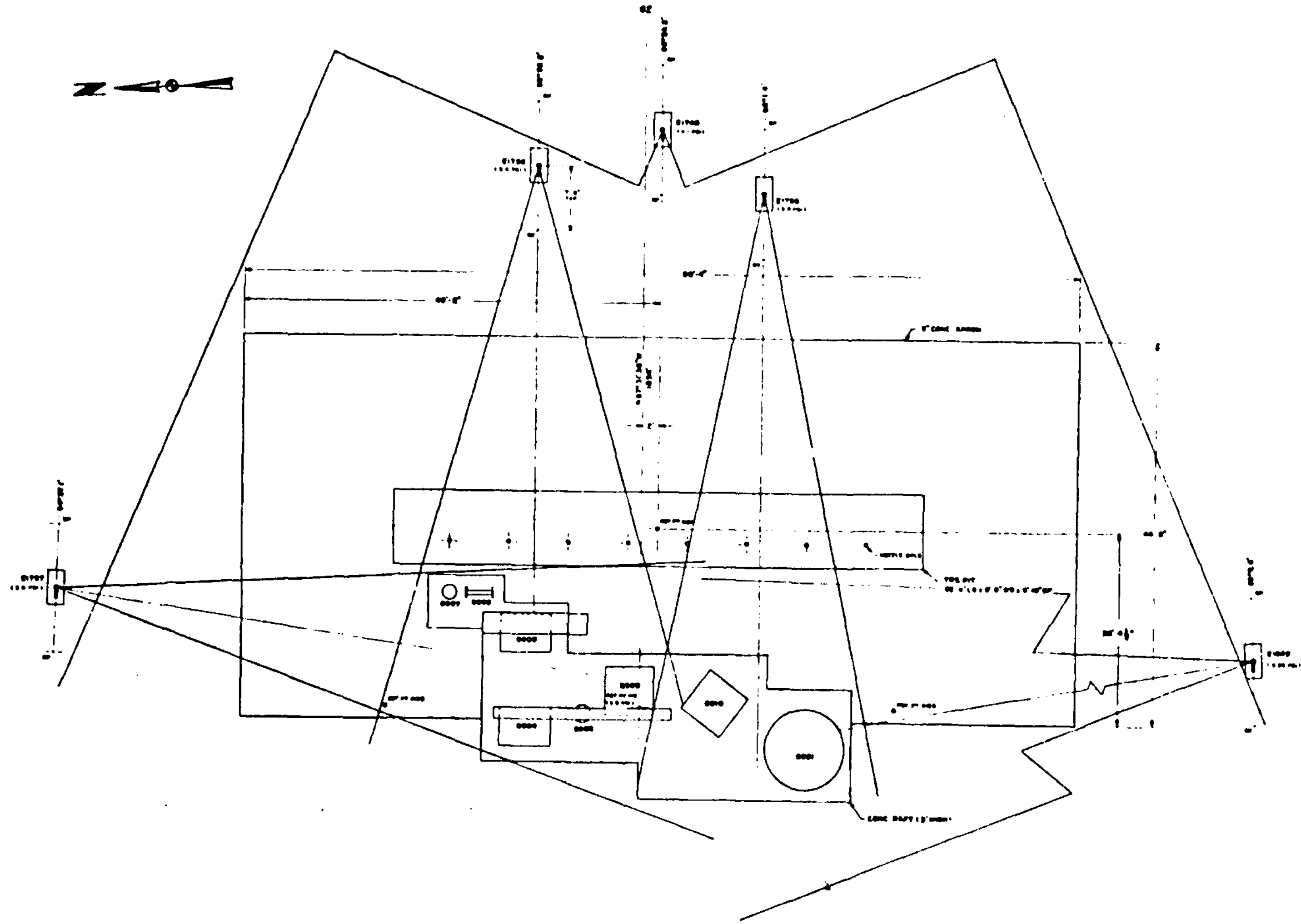


Figure 3-53. Camera coverage of experiments 8001, 3, 4, 5, 6, 7, 9, and 10.

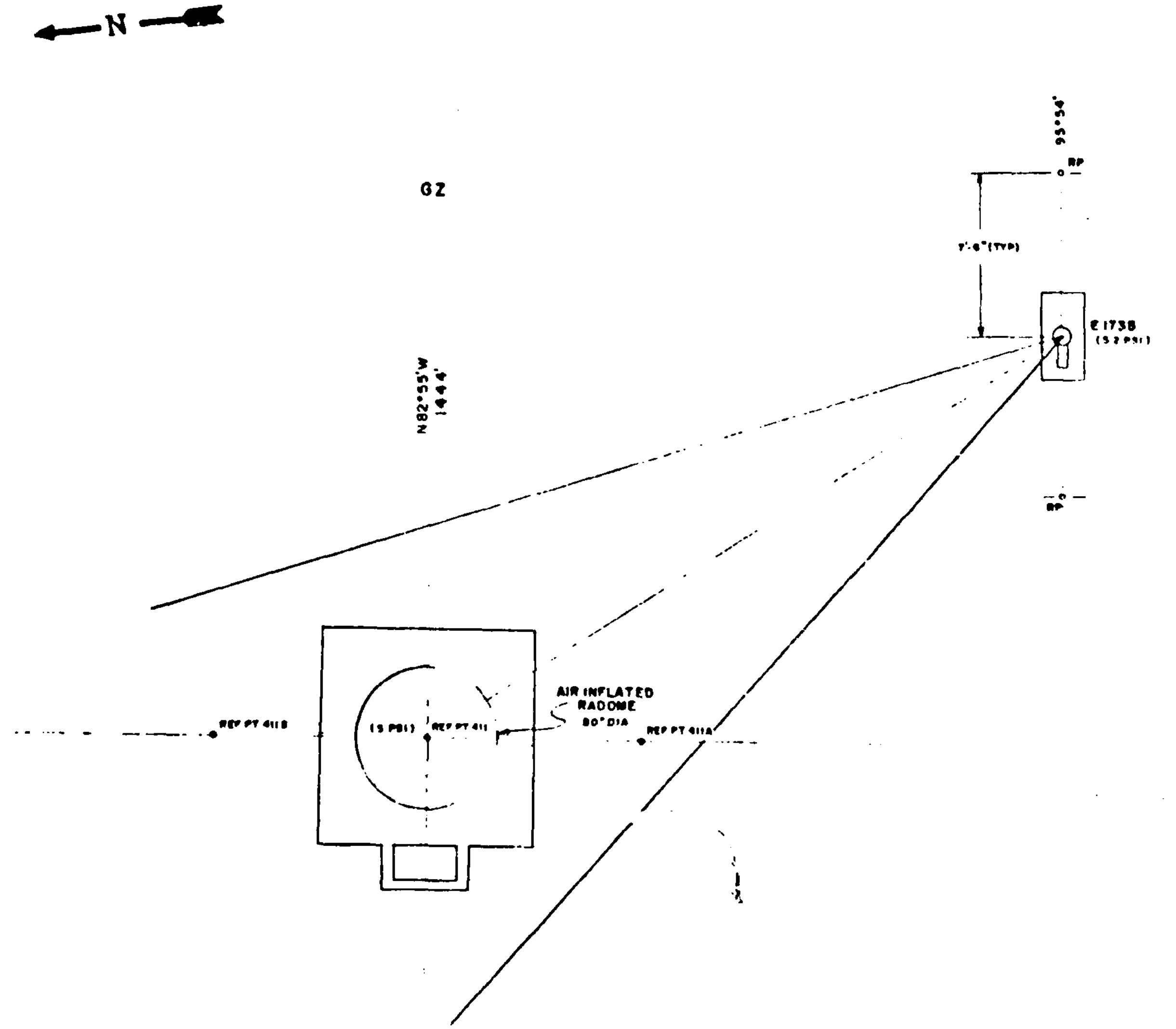


Figure 3-54. Camera coverage of experiment 8002.

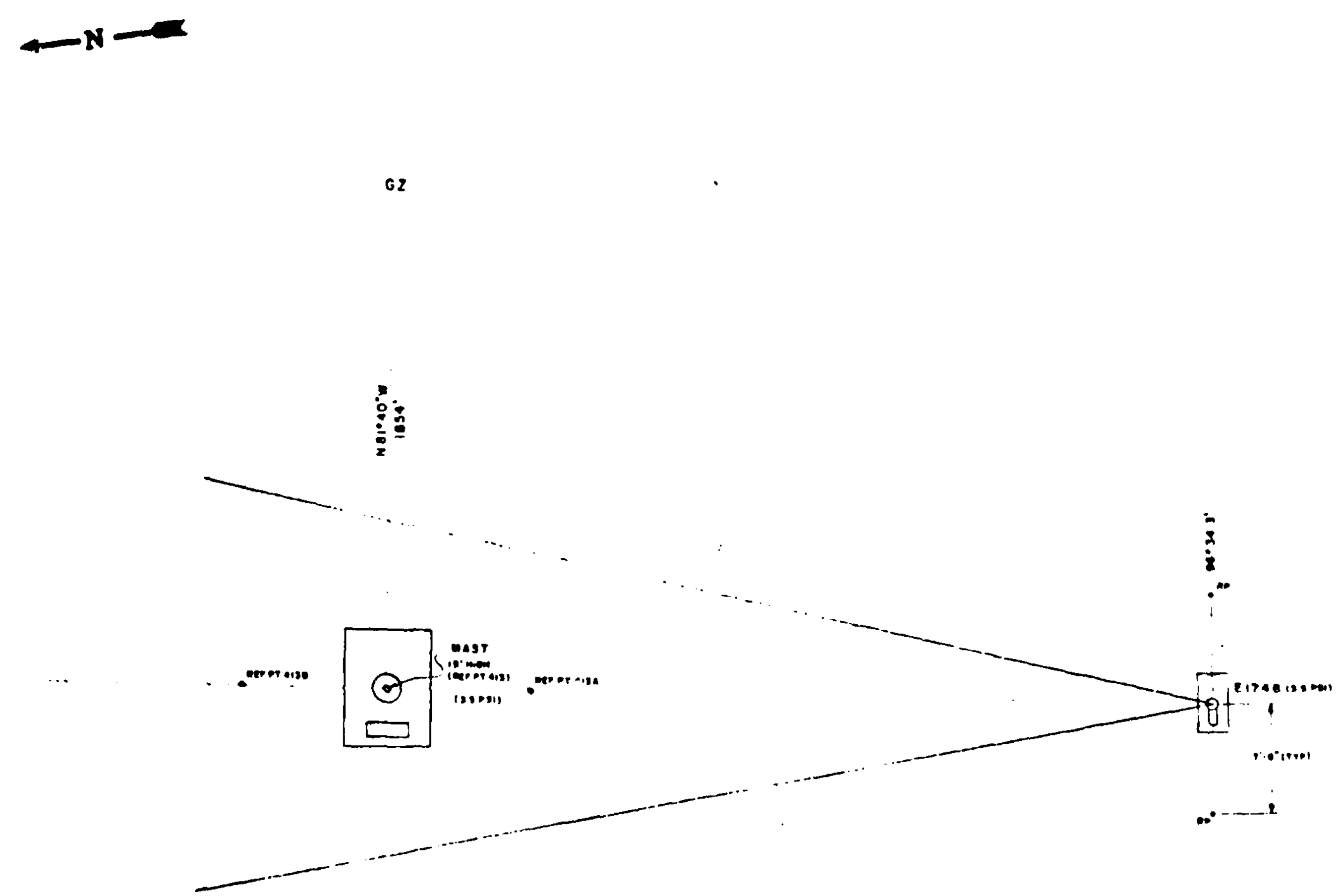


Figure 3-55. Camera coverage of experiment 8008.

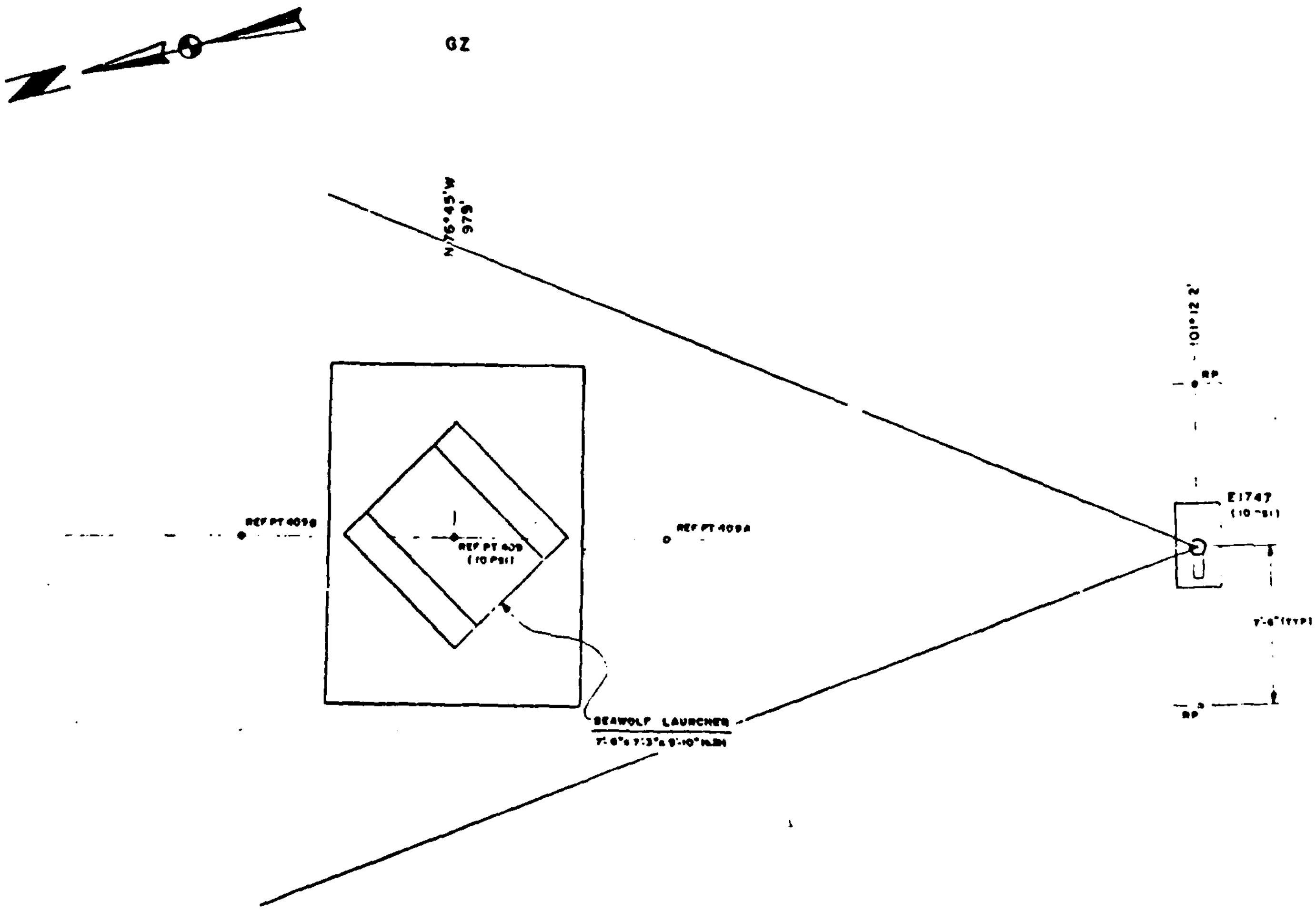


Figure 3-56. Camera coverage of experiment 8011.

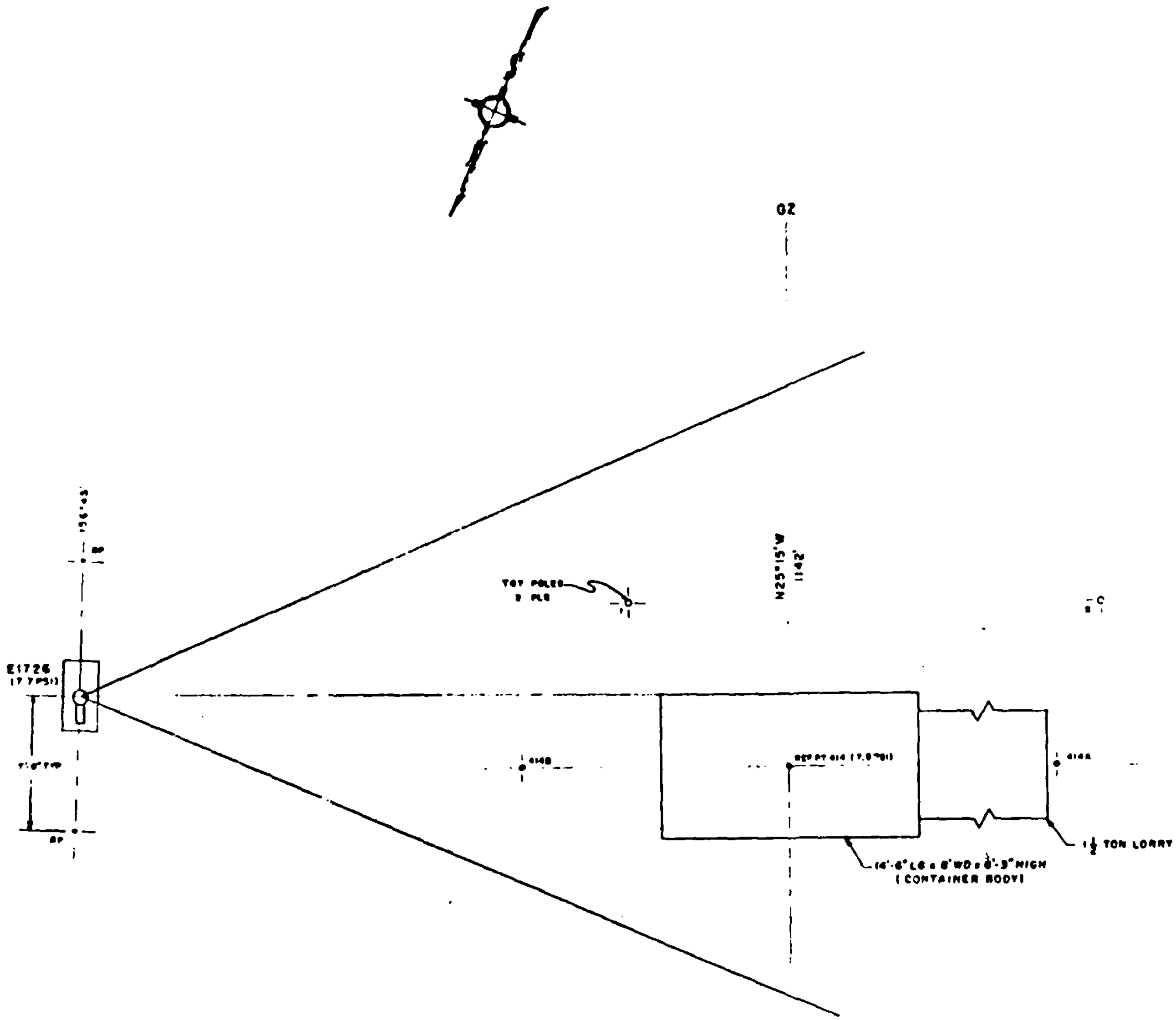


Figure 3-57. Camera coverage of experiment 8111.

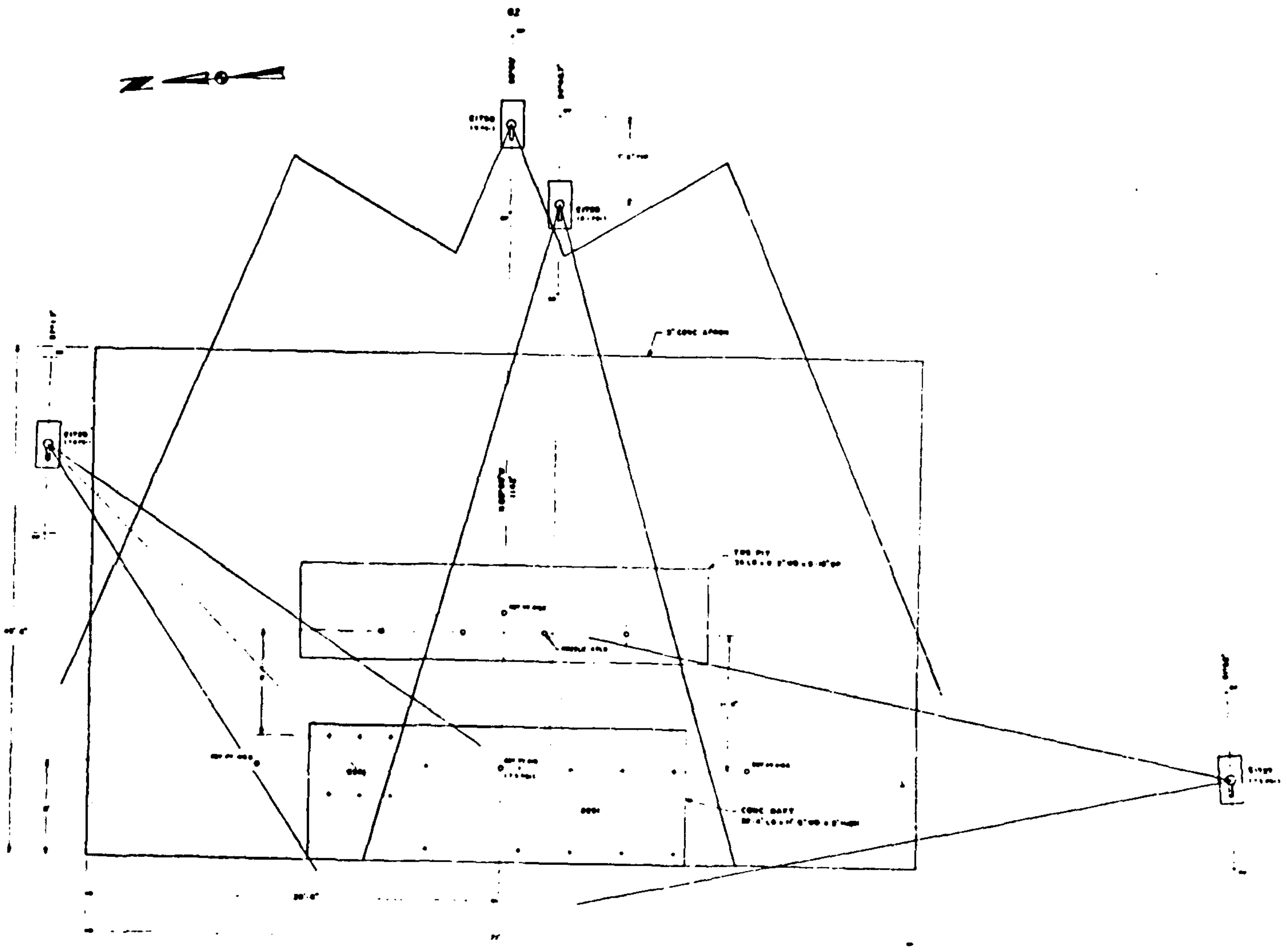


Figure 3-58. Camera coverage of experiments 8251/8301.

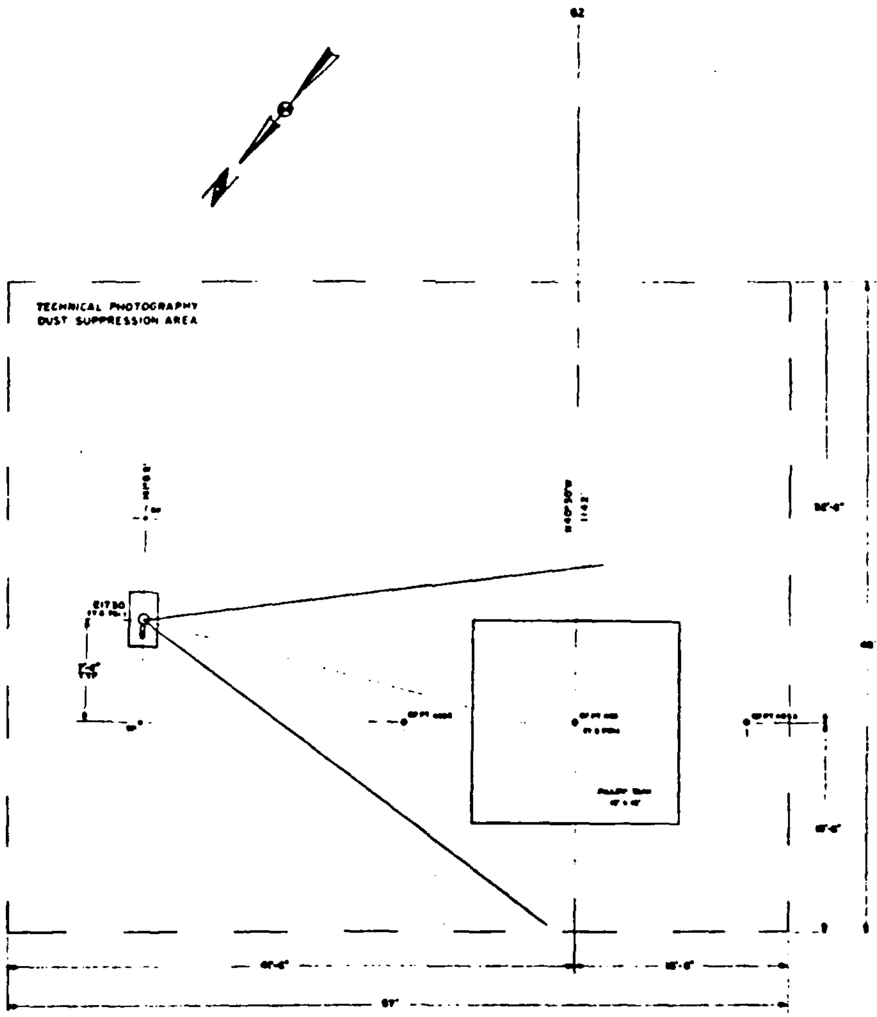


Figure 3-59. Camera coverage of experiment 8501.

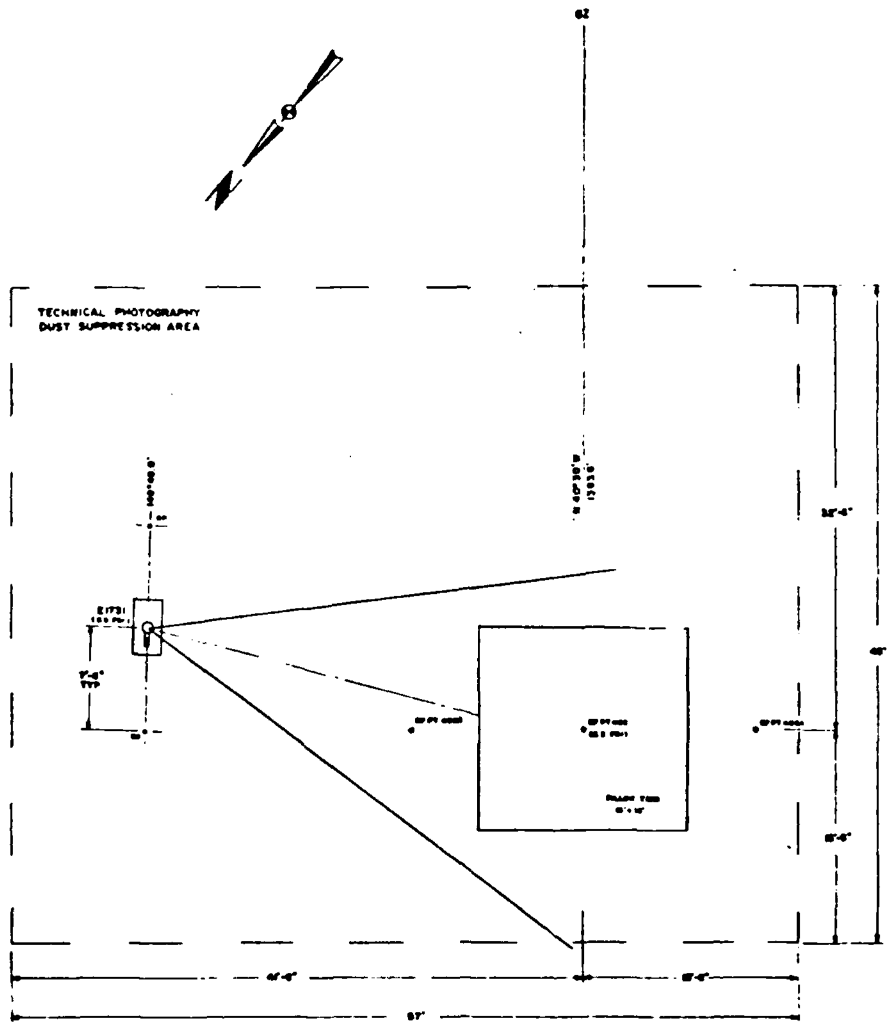


Figure 3-60. Camera coverage of experiment 8502.

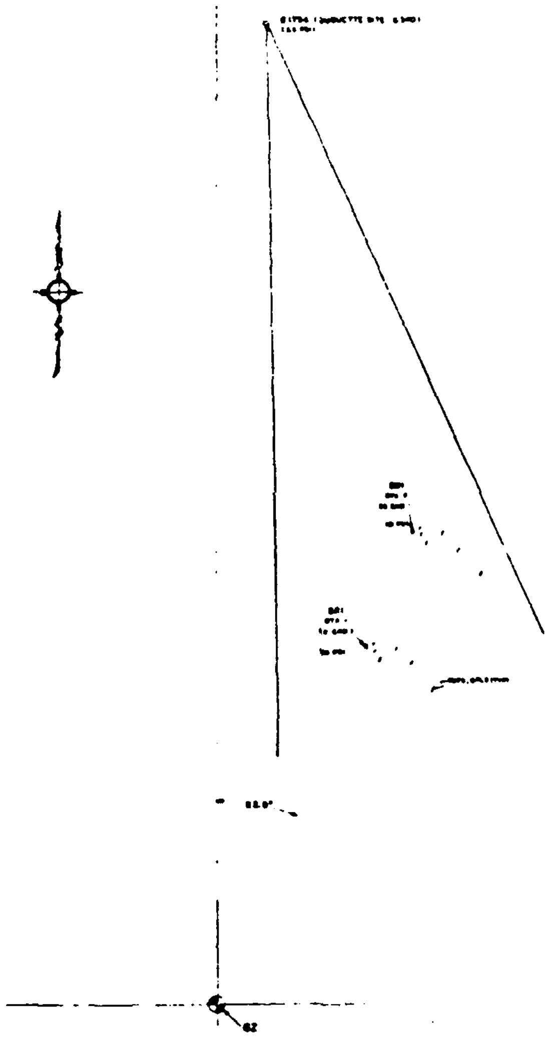


Figure 3-61. Camera coverage of experiment 9101.

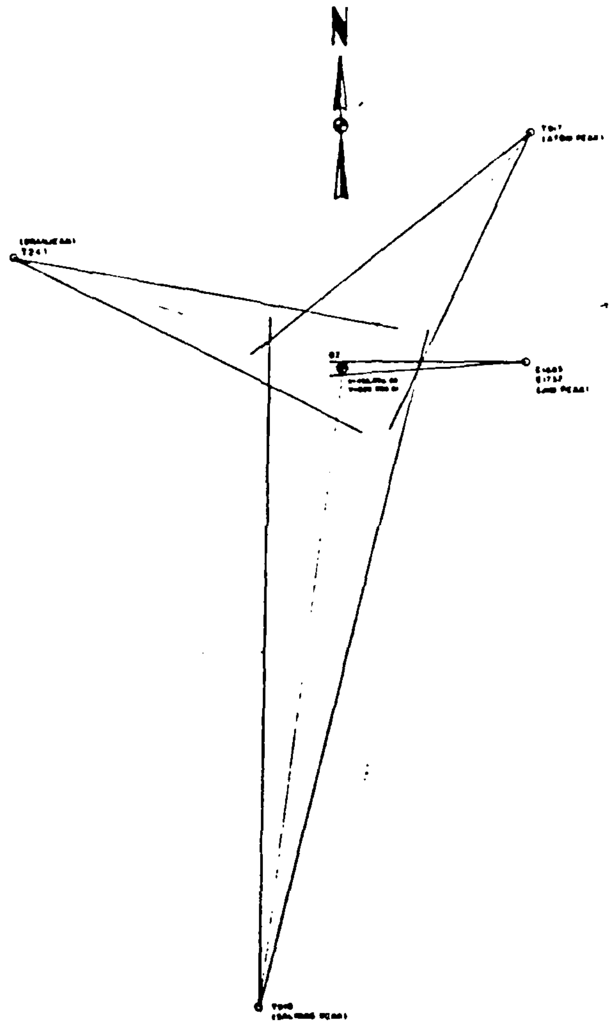


Figure 3-62. Camera coverage of experiment 9102.

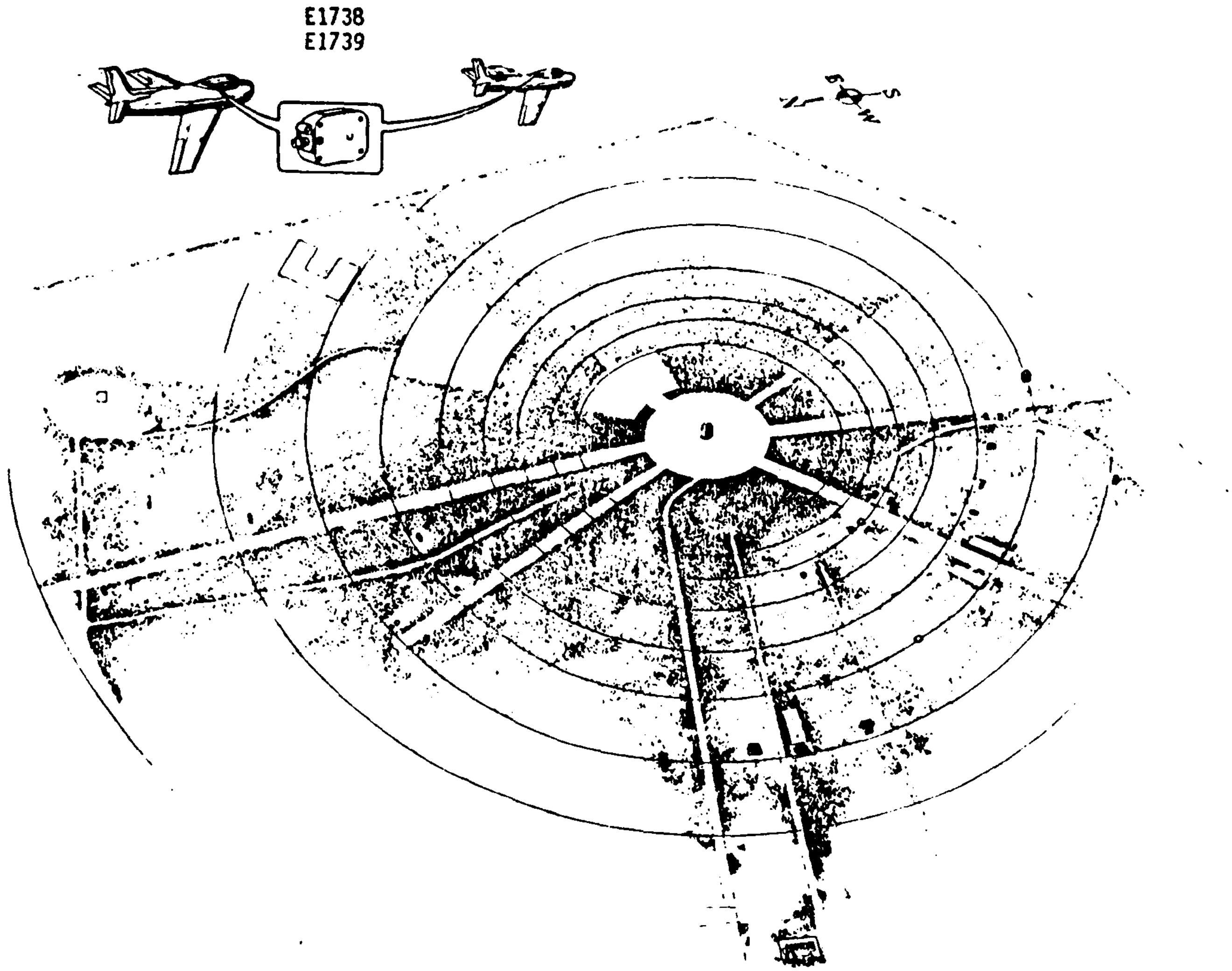


Figure 3-63. Camera coverage of experiment 9301.

Table 3-10. Camera designation, location, and instrumentation schedule.

Camera Number	Experiment	Mount	Camera	Lens Focal Length	Film	Min. Film Length	Frame Rate	Timing	Tgt Pole Reqm't	Camera Height	From Ref. Pt. Azimuth	Dist.	Camera Elev/Dep	Coverage Segment (s)
T241	DNA/SAI 9102	VTM	35mm	80mm	Color		24	IRIG B	No					-0 to +600
T788	DNA 9301 Drone A	VTM	35mm	50 in	Color	1200	500	IRIG A&B						-10 to +10
T818	DNA 9301 Drone B	VTM	35mm	50 in	Color	1200	500	IRIG A&B						-10 to +10
T917	DNA/SAI 9102	VTM	35mm	50mm	Color		24	IRIG B	No					-0 to +600
T918	DNA/SAI 9102	VTM	35mm	100mm	Color		24	IRIG B	No					-0 to +600
T928	DNA 9301 Drone A	VTM	70mm	180 in	Color	1200	120	IRIG A&B						-5 to +5
T928	DNA 9301 Drone A	VTM	35mm	100 in	Color	1200	250	IRIG A&B						-5 to +20
T929	DNA 9301	VTM	70mm	180 in	Color	1200	120	IRIG A&B						-30 to +5
T929	DNA 9301	VTM	35mm	100 in	Color	1200	250	IRIG A&B						
E1575	NAVSEA 1 3007	Fixed Pipe Type 1	16mm Fastax II	28mm	Color	450'	1K	1000 FIDU	No	7'	166°	47'	-5°	-5 to +10
E1585	NAVSEA 1 3001 & 7	Fixed Pipe Type 1	16mm Nova	35mm	Color	450'	2K	1000 FIDU	No	7'	32°18'	57'	-5°	-3 to +6
E1600	NAVSEA 1 3002, 3, 5 & 7	Fixed Pipe Type 1	16mm Nova	25mm	Color	450'	1K	1000 FIDU	Yes	7'	121°	79.9'	-5°	-5 to +10
E1603	BRL 2081	Fixed Pipe Type 2	16mm Nova	35mm	Color	450'	1K	1000 FL	Yes	7'	(B) 108°33'	83.2'	0°	-5 to +10
E1604	BRL 2081	Fixed Pipe Type 2	16mm Locam	25mm	Color	450'	400	100 FL	Yes	7'	(A) 291°47.9'	34.9'	0°	-5 to +10
E1605	BRL 2081	Interior	16mm Nova	13mm	Color	450'	1000	1000 FIDU	N/A	3.5'			+2°	-5 to +10

Table 3-10. Camera designation, location, and instrumentation schedule (continued).

Camera Number	Experiment	Mount	Camera	Lens Focal Length	Film	Min. Film Length	Frame Rate	Timing	Tgt Pole Reqm't	Camera Height	From Ref. Pt. Azimuth	Dist.	Camera Elev/Dep	Coverage Segment (s)
E1618	WES 2602	Interior	16mm Nova	11mm	Color	450'	2K	IRIG A with Inverter	N/A	5'			+11°	-2 to +7
E1661	BRL 2007	Fixed Pipe Type 1	16mm Milliken	25mm	Color	450'	400	100 FL	Yes	7'	7°20'	39'	0°	-5 to +10
E1662	BRL 2007	Fixed Pipe Type 1	16mm Milliken	12mm	Color	450'	400	100 FL	Yes	7'	67°13'	33'	0°	-5 to +10
E1663	BRL 2007	Fixed Pipe Type 1	16mm Milliken	13mm	Color	450'	400	100 FL	Yes	7'	167°20'	39'	0°	-5 to +5
E1664	BRL 2008	Fixed Pipe Type 1	16mm Milliken	12.5mm	Color	450'	400	100 FL	Yes	7'	310°34.8'	37'	0°	-5 to +10
E1665	BRL 2008	Fixed Pipe Type 1	16mm Milliken	12.5mm	Color	450'	400	100 FL	Yes	7'	105°20'	43'	0°	-5 to +10
E1666	BRL 2012	Interior	16mm Nova	11mm	Color	450'	1000	1000 T-0	No	4'			+2°	-7 to +5
E1667	BRL 2012	Fixed Pipe Type 1	16mm Milliken	12.5mm	Color	450'	400	100 FL	Yes	7'	0°48.8'	45'	0°	-5 to +10
E1668	BRL 2012	Fixed Pipe Type 1	16mm Nova	25mm	Color	450'	1000	1000 FL	Yes	7'	106°10.9'	35.46'	0°	-5 to +10
E1669	BRL 2053	Fixed Pipe Type 2	16mm Nova	13mm	Color	450'	1000	1000 FL	Yes	7'	85°6.8'	35.2'	0°	-5 to +10
E1670	BRL 2054	Fixed Pipe Type 2	16mm Nova	13mm	Color	450'	1000	1000 FL	Yes	7'	(B) 104°50.3'	18.05'	0°	-5 to +10
E1671	BRL 2057	Fixed Pipe Type 1	16mm Nova	13mm	Color	450'	1000	1000 FL	Yes	7'	93°40.1'	35.2'	0°	-5 to +10

Table 3-10. Camera designation, location, and instrumentation schedule (continued).

Camera Number	Experiment	Mount	Camera	Lens Focal Length	Film	Min. Film Length	Frame Rate	Timing	Tgt Pole Reqm't	Camera Height	From Ref. Pt. Azimuth	Dist.	Camera Elev/Dep	Coverage Segment (s)
E1672	BRL 2053	Fixed Pipe Type 2	16mm Milliken	13mm	Color	450'	400	100 FL	Yes	7'	57°40.4'	34.8'	0°	-5 to +10
E1673	BRL 2054	Fixed Pipe Type 2	16mm Milliken	16mm	Color	450'	400	100 FL	Yes	7'	(A) 273°14.5'	22.77'	0°	-5 to +10
E1674	BRL 2057	Fixed Pipe Type 1	16mm Milliken	12.5mm	Color	450'	400	100 FL	Yes	7'	66°13.7'	34.8'	0°	-5 to +10
E1675	BRL 2055	Fixed Pipe Type 2	16mm Nova	11mm	Color	450'	1000	1000 FL	Yes	7'	151°20.5'	17.6'	0°	-5 to +10
E1676	BRL 2055	Interior	16mm Fastax II	28mm	Color	450'	1000	1000 FIDU	No	4.5'			+6°	-5 to +10
E1677	BRL 2055	Interior	16mm Fastax II	28mm	Color	450'	1000	1000 FIDU	No	4.5'			+6°	-5 to +10
E1678	BRL 2056	Fixed Pipe Type 2	16mm Nova	13mm	Color	450'	1000	1000 FL	No	7'	103°2.4'	18'	0°	-5 to +10
E1679	BRL 2056	Interior	16mm Fastax II	28mm	Color	450'	1000	1000 FIDU	N/A	5.5'			+6°	-5 to +10
E1680	BRL 2056	Interior	16mm Fastax II	28mm	Color	450'	1000	1000 FIDU	No	5.5'			+6°	-5 to +10
E1681	BRL 2053	Fixed Pipe Type 2	16mm Nova	25mm	Color	450'	1000	1000 FL	Yes	7'	105°58.4'	32'	0°	-5 to +10
E1682	BRL 2054	Interior	16mm Fastax II	28mm	Color	450'	1000	1000 FIDU	N/A	5.5'			+6°	-5 to +10
E1684	NAVSEA 1 3001, 2, 3, 5 & 7	Fixed Pipe Type 1	16mm Nova	25mm	Color	450'	1000	1000 FIDU	No	7'	125°58.9'	69.2'	0°	-7 to +10

Table 3-10. Camera designation, location, and instrumentation schedule (continued).

Camera Number	Experiment	Mount	Camera	Lens Focal Length	Film	Min. Film Length	Frame Rate	Timing	Tgt Pole Reqm't	Camera Height	From Ref. Pt. Azimuth	Dist.	Camera Elev/Dep	Coverage Segment (s)
E1685	DNA/SRI 9102	Tripod	16mm Locam	150mm	ER IR	450'	250	100 FL	No					T-5 to T+20 Seconds
E1686	NAVSEA 1 3001, 2, 3, & 5	Fixed Pipe Type 1	16mm Nova	13mm	Color	450'	1000	1000 FIDU	No	7'	155°12.9'	60.5'	0°	-5 to +10
E1687	FEMA 5401	Fixed Pipe Type 1	16mm Nova	13mm	Color	450'	1000	1000 FL	Yes	7'	(B) 61°9.8'	27.51'	5°	-5 to +10
E1688	FEMA 5401	Fixed Pipe Type 1	16mm Nova	13mm	Color	450'	1000	1000 FL	Yes	7'	(A) 16°30.1'	27.51'	-5°	-5 to +10
E1689	FEMA 5401	Fixed Pipe Type 1	16mm Ncva	13mm	Color	450'	1000	1000 FL	Yes	7'	(B) 202°22.9'	28.74'	-5°	-5 to +10
E1690	FEMA 5402	Fixed Pipe Type 1	16mm Nova	11mm	Color	450'	1000	1000 FL	Yes	7'	(B) 92°49.8'	27.51'	-5°	-5 to +10
E1691	FEMA 5402	Fixed Pipe Type 1	16mm Nova	11mm	Color	450'	1000	1000 FL	Yes	7'	(A) 48°10.1'	27.51'	-5°	-5 to +10
E1692	FEMA 5402	Fixed Pipe Type 1	16mm Nova	11mm	Color	450'	1000	1000 FL	Yes	7'	(B) 234°03'	28.74'	-5°	-5 to +10
E1693	FEMA 5403	Fixed Pipe Type 1	16mm Nova	13mm	Color	450'	1000	1000 FL	Yes	7'	(B) 80°39.7'	27.51'	-5°	-5 to +10
E1694	FEMA 5403	Fixed Pipe Type 1	16mm Nova	13mm	Color	450'	1000	1000 FL	Yes	7'	(A) 36°01'	27.51'	-5°	-5 to +10
E1695	FEMA 5403	Fixed Pipe Type 1	16mm Nova	13mm	Color	450'	1000	1000 FL	Yes	7'	(B) 221°52.9'	28.74'	-5°	-5 to +10
E1696	FEMA 5003	Interior	16mm Locam	5.3mm	Color	450'	400	100 T-0	N/A	5.5'			0°	-5 to +12

Table 3-10. Camera designation, location, and instrumentation schedule (continued).

Camera Number	Experiment	Mount	Camera	Lens Focal Length	Film	Min. Film Length	Frame Rate	Timing	Tgt Pole Reqm't	Camera Height	From Ref. Pt. Azimuth	Dist.	Camera Elev/Dep	Coverage Segment (s)
E1697	FEMA 5201	Interior	16mm Milliken	12.5mm	Color	450'	400	100 T-0	N/A	4'			0°	-5 to +12
E1698	FEMA 5201	Interior	16mm Milliken	12.5mm	Color	450'	400	100	N/A	6'			0°	-5 to +12
E1699	FEMA 5501	Fixed Pipe Type 1	16mm Milliken	25mm	Color	450'	1 Slow as pos-sible	None FL	No	4'	77°8'	64.3'	-1°	-5 to +60
E1700	FEMA 5501	Fixed Pipe Type 1	16mm Fastax II	28mm	Color	450'	1000	1000 FL	No	4'	80°36'	63.2'	-1°	-5 to +10
E1701	FEMA 5502	Fixed Pipe Type 1	16mm Milliken	25mm	Color	450'	1 Slow as pos-sible	None FL	No	4'	63°12'	71'	-1°	-5 to +60
E1702	FEMA 5502	Fixed Pipe Type 1	16mm Nova	16mm	Color	450'	1000	1000 FL	No	4'	68°9'	69.5'	-1°	-5 to +10
E1703	FEMA 5503	Fixed Pipe Type 2	16mm Milliken	25mm	Color	450'	1 Slow as pos-sible	None FL	No	10'	108°57'	71.9'	-1°	-5 to +60
E1704	FEMA 5503	Fixed Pipe Type 2	16mm Nova	25mm	Color	450'	1000	1000 FL	No	10'	113°23'	74.2'	-1°	-5 to +10
E1705	WSMR/Lovelace 2301/2311	Fixed Pipe Type 1	16mm Milliken	13mm	Color	450'	400	100 T-0	No	7'	73°11.6'	50.5'	0°	-5 to +10
E1706	WSMR/Lovelace 2301/2311	Fixed Pipe Type 1	16mm Locam	12.5mm	Color	450'	400	100 T-0	No	7'	129°10.3'	44.64'	0°	-5 to +10
E1707	WSMR/Lovelace 2302/2311	Fixed Pipe Type 1	16mm Locam	10mm	Color	450'	400	100 T-0	No	7'	35°32.1'	42.86'	0°	-5 to +10

Table 3-10. Camera designation, location, and instrumentation schedule (continued).

Camera Number	Experiment	Mount	Camera	Lens Focal Length	Film	Min. Film Length	Frame Rate	Timing	Tgt Pole Reqm't	Camera Height	From Ref. Pt. Azimuth	Dist.	Camera Elev/Dep	Coverage Segment (s)
E1708	WSMR/Lovelace 2302/2311	Fixed Pipe Type 1	16mm Milliken	12mm	Color	450'	400	100 T-0	No	7'	276°16.3'	28.14'	0°	-5 to +10
E1709	WSMR/Lovelace 2303/2311	Fixed Pipe Type 1	[illegible] Milliken	25mm	Color	450'	400	100 T-0	No	7'	268°45.7'	33.9'	-3°	-5 to +10
E1710	WSMR/Lovelace 2303/2311	Fixed Pipe Type 1	16mm Milliken	12mm	Color	450'	400	100 T-0	No	7'	68°33'	45.9'	0°	-5 to +10
E1711	WSMR/Lovelace 2305/2311	Fixed Pipe Type 2	16mm Milliken	25mm	Color	450'	400	100 T-0	No	7'	289°45.8'	34.98'	-3°	-5 to +10
E1712	WSMR/Lovelace 2305/2311	Fixed Pipe Type 2	16mm Locam	12.5mm	Color	450'	400	100 T-0	No	7'	47°43'	34.74'	0°	-5 to +10
E1715	AFWL 4501	Fixed Pipe Type 1	16mm Locam	150mm	Color	450'	300	100 FL	No	7'			-1°	-5 to +40
E1716	AFWL 4501	Fixed Pipe Type 1	16mm Locam	25mm	Color	450'	300	100 FL	No	18"			+1°	-5 to +40
E1717	AFWL 4501	Fixed Pipe Type 1	16mm Locam	25mm	Color	450'	300	100 FL	No	18"			+1°	-5 to +40
E1718	AFWL 4501	Fixed Pipe Type 1	16mm Locam	13mm	Color	450'	300	100 FL	No	12"			-1°	-5 to +40
E1719	AFWL 4501	Fixed Pipe Type 1	16mm Locam	25mm	Color	450'	300	100 FL	No	18"			-1.5°	-5 to +40
E1723	NAVSEA 1 3007	Fixed Pipe Type 1	16mm Nova	35mm	Color	450'	1000	1000 FIDU	No	7'	7°54.5'	49.6'	-6°	-7 to +10
E1724	NAVSEA 1 3007	Fixed Pipe Type 1	16mm Fastax II	28mm	Color	450'	1000	1000 FIDU	No	7'	346°	47'	0°	-5 to +10

Table 3-10. Camera designation, location, and instrumentation schedule (continued).

Camera Number	Experiment	Mount	Camera	Lens Focal Length	Film	Min. Film Length	Frame Rate	Timing	Tgt Pole Reqm't	Camera Height	From Ref. Pt. Azimuth	Dist.	Camera Elev/Dep	Coverage Segment (s)
E1725	UK 1 8001 & 10	Fixed Pipe Type 2	16mm Locam	25mm	Color	450'	400	100 T-0	No	7'	105°36.3'	61.6'	0°	-5 to +12
E1726	UK 8111	Fixed Pipe Type 1	16mm Locam	12.5mm	Color	450'	400	100 FL	Yes	7'	70°28'	40.19'	0°	-5 to +12
E1727	UK 2 8251	Fixed Pipe Type 1	16mm Locam	25mm	Color	450'	400	100 T-0	No	7'	185°	62.5'	0°	-5 to +12
E1728	UK 2 8251	Fixed Pipe Type 1	16mm Locam	13mm	Color	450'	400	100 T-0	No	7'	100°3.5'	48.18'	0°	-5 to +12
E1729	UK 2 8301	Fixed Pipe Type 1	16mm Locam	25mm	Color	450'	400	100 T-0	No	7'	39°15'	47.8'	-5°	-5 to +12
E1730	UK 8501	Fixed Pipe Type 1	16mm Locam	12.5mm	Color	450'	400	100 FL	No	4'	62°53.5'	32.4'	-3°	-5 to +12
E1731	UK 8502	Fixed Pipe Type 1	16mm Locam	12.5mm	Color	450'	400	100 FL	No	4'	62°53.5'	32.4'	-3°	-5 to +12
E1732	DNA/SAI 9102	Tripod	16mm Locam	150mm	Color	450'	250	100 FL	No					T-5 to T+20 Seconds
E1734	DNA/TBE 9101	Fixed Pipe Type 2	16mm Locam	25mm	Color	450'	24	100 FL	No	7'	90°	10'	0°	-10 to End of Film
E1735	UK 8002	Fixed Pipe Type 1	16mm Locam	18mm	Color	450'	400	100 T-0	No	7'	154°8.8'	34.94'	-3°	-5 to +12
E1736	UK 1 8003, 4, 5, 6, 7, & 9	Fixed Pipe Type 2	16mm Locam	18mm	Color	450'	400	100 T-0	No	7'	81°14.9'	64.2'	0°	-5 to +12
E1737	UK 1 8001, 3, 4, 5, 6, 7, 9 & 10	Fixed Pipe Type 2	16mm Locam	25mm	Color	450'	400	100 T-0	No	7'	13°32.5'	70.3'	0°	-5 to +12

Table 3-10. Camera designation, location, and instrumentation schedule (continued).

Camera Number	Experiment	Mount	Camera	Lens Focal Length	Film	Min. Film Length	Frame Rate	Timing	Tgt Pole Reqm't	Camera Height	From Ref. Pt. Azimuth	Dist.	Camera Elev/Dep	Coverage Segment (s)
E1738	DNA (Airborne)	ARCFT	16mm Milliken	12.5mm	Color	450'	400	IRIG B	N/A					T-30 to T+10
E1739	DNA (Airborne)	ARCFT	16mm Milliken	12.5mm	Color	450'	400	IRIG B	N/A					T-30 to T+10
E1742	WES 2601	Fixed Pipe Type 1	16mm Locam	25mm	Color	450'	400	IRIG A with Inverter	Yes	7'	113°40'	37'	-1°	-5 to +12
E1743	WES 2601	Fixed Pipe Type 1	16mm Fastax II	28mm	Color	450'	2K	IRIG A	Yes	7'	44°35'	43.8'	-1°	-2 to +7
E1744	WES 2602	Fixed Pipe Type 1	16mm Locam	13mm	Color	450'	2K	IRIG A	Yes	7'	22°17.9'	67.2'	+5°	-2 to +7
E1745	WES 2502	Fixed Pipe Type 1	16mm Locam	12.5mm	Color	450'	400	IRIG A	Yes	7'	1[illegible]6°10.7'	58.5'	+5°	-5 to +12
E1746	UK 8008	Fixed Pipe Type 2	16mm Locam	25mm	Color	450'	400	100 T-0	No	7'	188°20'	47'	0°	-5 to +12
E1747	UK 8011	Fixed Pipe Type 1	16mm Locam	13mm	Color	450'	400	100 T-0	No	7'	193°17.9'	25'	-3°	-5 to +12
E1748	UK 1 TRS	Fixed Pipe Type 1	16mm Locam	12mm	Color	450'	400	100 T-0	No	7'	93°9.3'	167.63'	+5°	-10 to +10
E1749	BRL 1 TRS	Fixed Pipe Type 1	16mm Locam	12mm	Color	450'	400	100 T-0	No	7'	84°50'	78.5'	+5°	-10 to +10
E1750	UK 2 TRS	Fixed Pipe Type 1	16mm Locam	12.5mm	Color	450'	400	100 T-0	Yes	7'	95°	95.5'	+5°	-10 to +10
E1751	NAVSEA 1 TRS	Fixed Pipe Type 1	16mm Locam	12.5mm	Color	450'	400	100 T-0	No	7'	76°	105'	+5°	-10 to +10

Table 3-10. Camera designation, location, and instrumentation schedule (continued).

Camera Number	Experiment	Mount	Camera	Lens Focal Length	Film	Min. Film Length	Frame Rate	Timing	Tgt Pole Reqm't	Camera Height	From Ref. Pt. Azimuth	Dist.	Camera Elev/Dep	Coverage Segment (s)
E1752	Lovelace/WSMR 2311/2301	Interior	16mm Locam	10mm	Color	450'	200	100 T-0	N/A					-5 to +12
E1753	Lovelace/WSMR 2311/2302	Interior	16mm Locam	10mm	Color	450'	200	100 T-0	N/A					-5 to +12
E1754	Lovelace/WSMR 2311/2303	Interior	16mm Locam	5.7mm	Color	450'	200	100 T-0	N/A					-5 to +12
E1755	Lovelace/WSMR 2311/2303	Interior	16mm Locam	12mm	Color	450'	200	100 T-0	N/A					-5 to +12
E1756	Lovelace/WSMR 2311/2305	Fixed Pipe "A" Frame	16mm Locam	12mm	Color	450'	200	100 T-0	N/A	13'			-45	-5 to +12
E1842	UK 1 8001	Fixed Pipe Type 2	16mm Locam	25mm	Color	450'	400	100 FL	No	7'	175°48.6'	107.7'	0°	-5 to +12

3-12 OTHER TECHNICAL SUPPORT.

The following additional technical support was provided to MILL RACE by the organizations indicated:

a. Advisory and Consultant Capacity

AFWL conducted a geological site investigation to determine the best location for ground zero. BRL provided airblast predictions out to 14,000 feet (4.28 km).

b. Far Field Airblast Damage Predictions and Barograph Measurements

SNLA provided predictions of airblast propagation, based on meteorological conditions. This was to help avoid offsite damage effects, to measure small pressure amplitudes in selected, representative locations verifying predictions, and to provide factual data for any damage claim adjustments.

c. Documentary Photography

The WSMR contractor, Dynalectron Corporation, provided photographic support to participating agencies and FCDNA. Still photographs were taken to document progress. In addition to black and white and color photographs, motion picture documentary film was taken of testbed activities and experiment construction for the primary purpose of producing a documentary movie. WAC took aerial black and white and color pre- and postshot photographs.

d. Engineering Support

Ken O'Brien Associates, Albuquerque, NM, provided engineering field support, testbed layout drawings, design of TRS pits, and construction drawings for some experimenters.

e. Meteorology Support

This effort by the WSMR Meteorological Team of the Atmospheric Science Laboratory provided wind direction and velocity, air temperature, and humidity as a function of altitude. This information was also recorded for use in predicting far field airblast damage and was used in making the "go" decision for MILL RACE execution. Readings were taken at the SOTIM-3 site at the intersection of WSMR Routes 7 and 13.

f. Technical Reports

TRI, Albuquerque, NM, prepared the camera-ready copies for the Program Document, the changes thereto, and the Test Execution Report. Camera-ready copies from the MILL RACE Symposium will also be prepared by TRI.

SECTION 4

EXPERIMENTS

MILL RACE experiments were classified into one of the following four general categories:

a. Phenomenology

b. Structures

c. Systems Vulnerability

d. Dust and Debris.

Figures 4-1 and 4-2 depict the MILL RACE testbed. Table 4-1 lists the experiments by experiment number. Experiment results are published in a Project Officer Report (POR) entitled MILL RACE Results Symposium.

4-1 PHENOMENOLOGY.

4-1.1 Ground Motion Measurements (9001).

Ground motion measurements were sponsored by DNA. Gages were installed and data recorded by the U.S. Army Waterways Experiment Station (WES).

OBJECTIVE: Field a combined ground-shock experiment to measure, record, and evaluate the ground shock in support of strain path prediction techniques.

DESCRIPTION: Forty ground motion gages were placed at nine locations (see Figure 4-3) in close proximity to structure experiments. Sixty-six gages (five lost due to lightning activity before detonation) were fielded to record data for the strain path prediction techniques. These gages were located at three points each along the 240° and 328° radials. Twenty gages were fielded at four locations on the 315° radial in support of pore air studies. Figure 4-4 shows the locations of the gages supporting the strain path and pore air studies. Figure 4-5 shows a ground motion sensor being installed.

4-1.2 Free Field Airblast Measurements (9901).

These measurements were sponsored by DNA. US Army BRL installed gages and recorded data.

OBJECTIVE: Measure and record time of arrival, amplitude and waveshape of airblast overpressures.

DESCRIPTION: [redacted] A total of 100 free-field airblast measurements were made. DNA (b)(3) Sixty-eight gages were installed along the three main radials (North, South and TRS). Other gages were strategically placed adjacent to experiments where accurate overpressure readings were essential. Location of the gages is shown in Figure 4-7.

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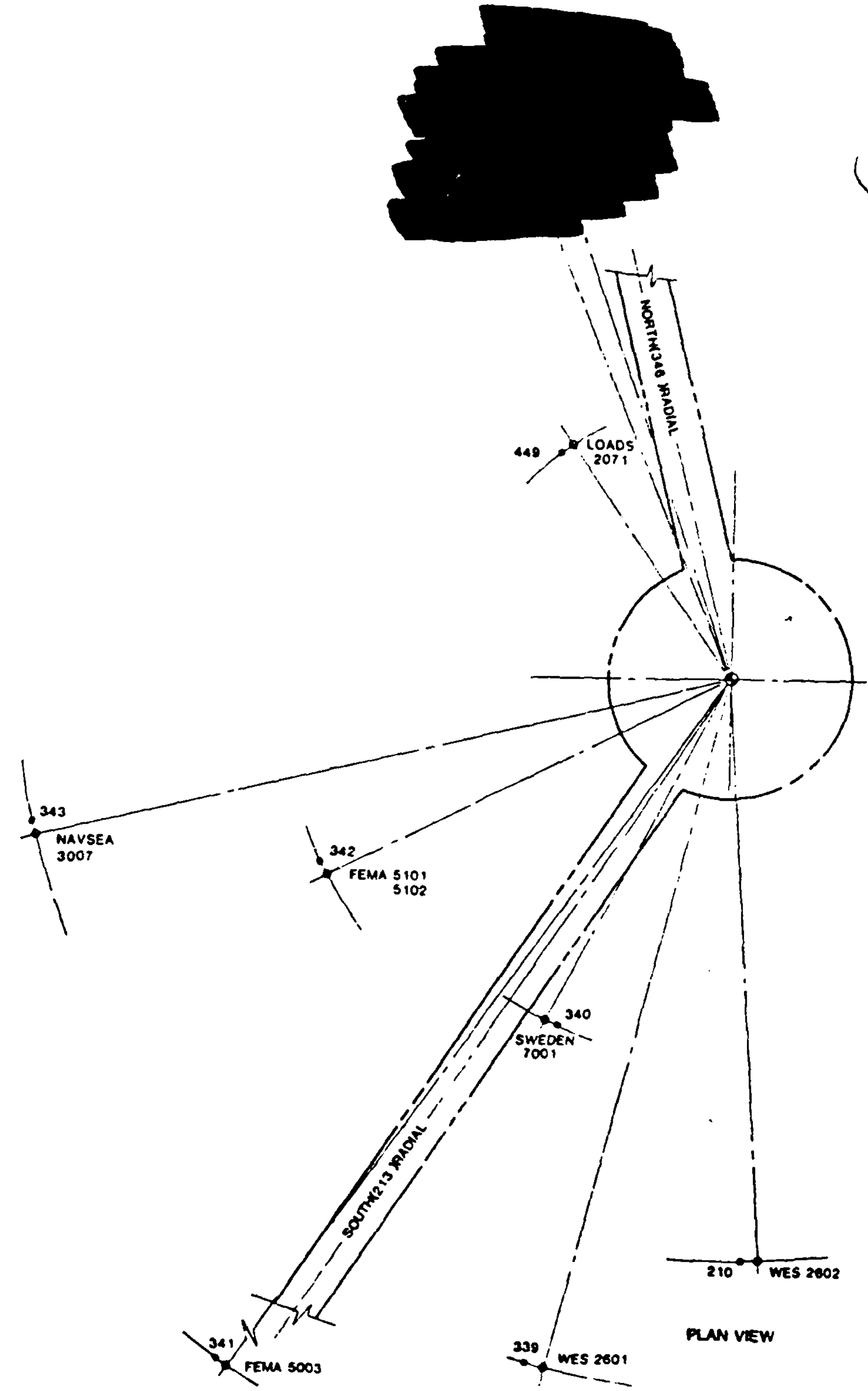

Figure 4-3. Location of ground motion gages supporting structure experiments.

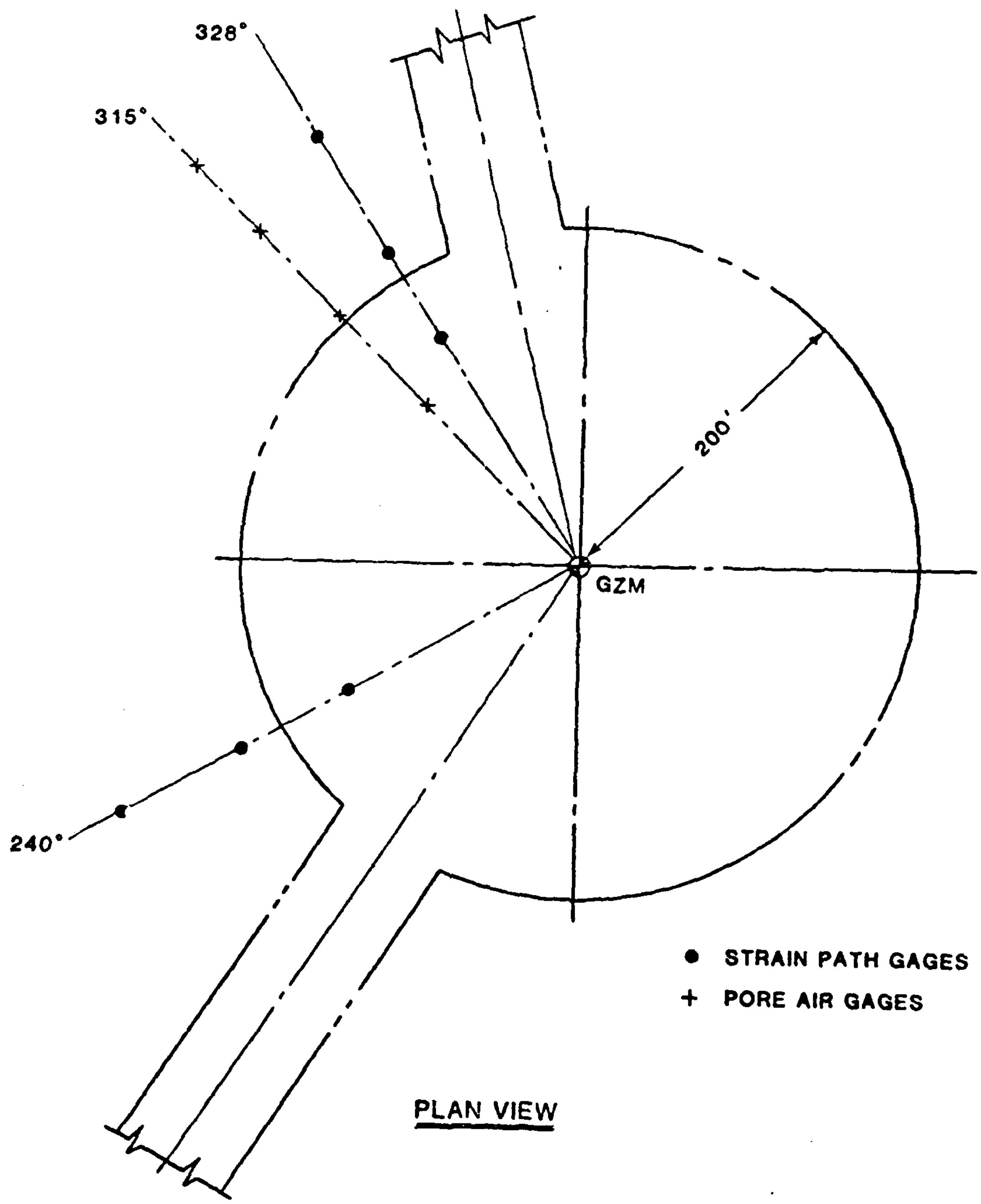

Figure 4-4. Location of ground motion gages supporting strain path and pore air experiments.

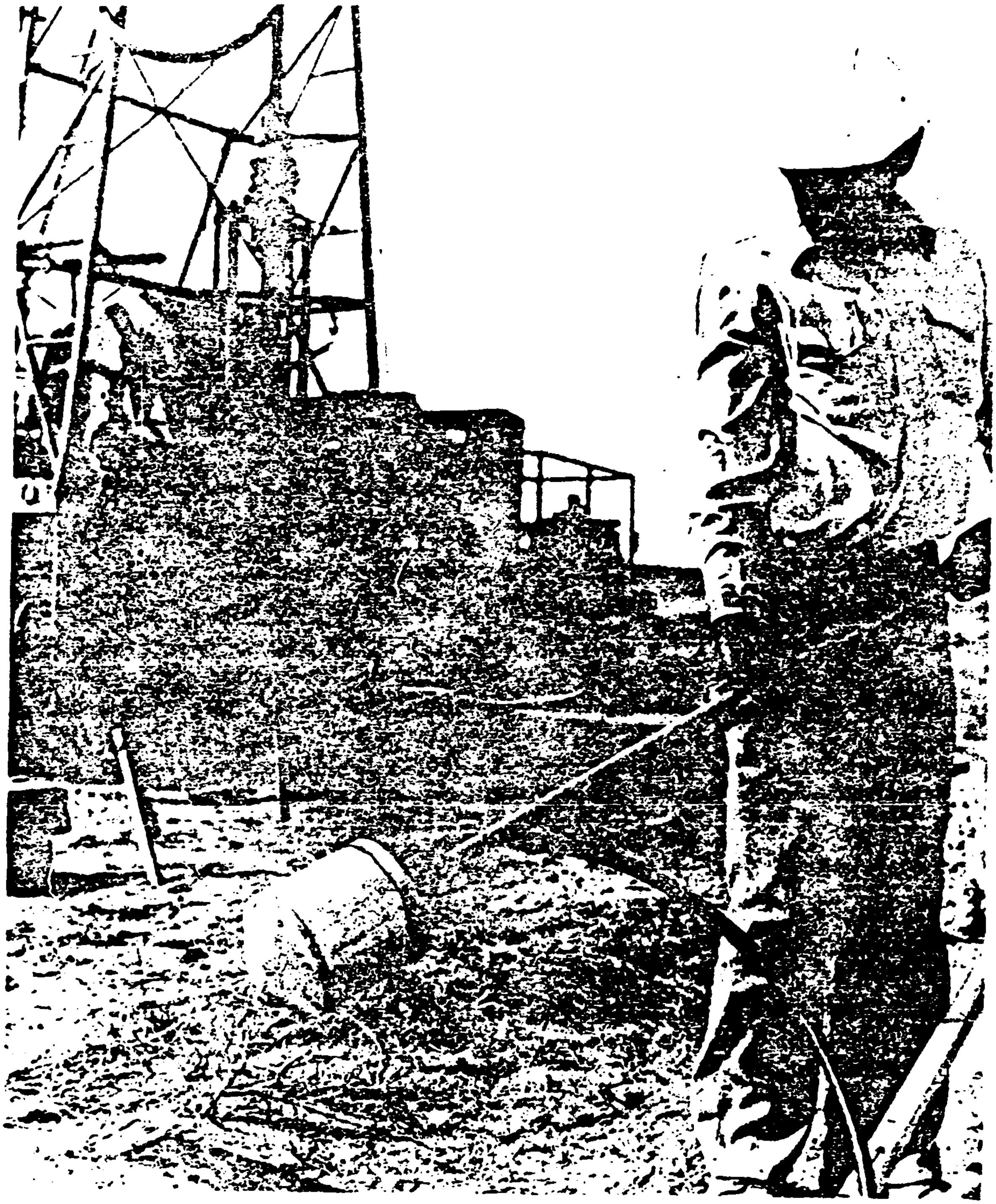

Figure 4-5. Ground motion sensor (DNA 9001).

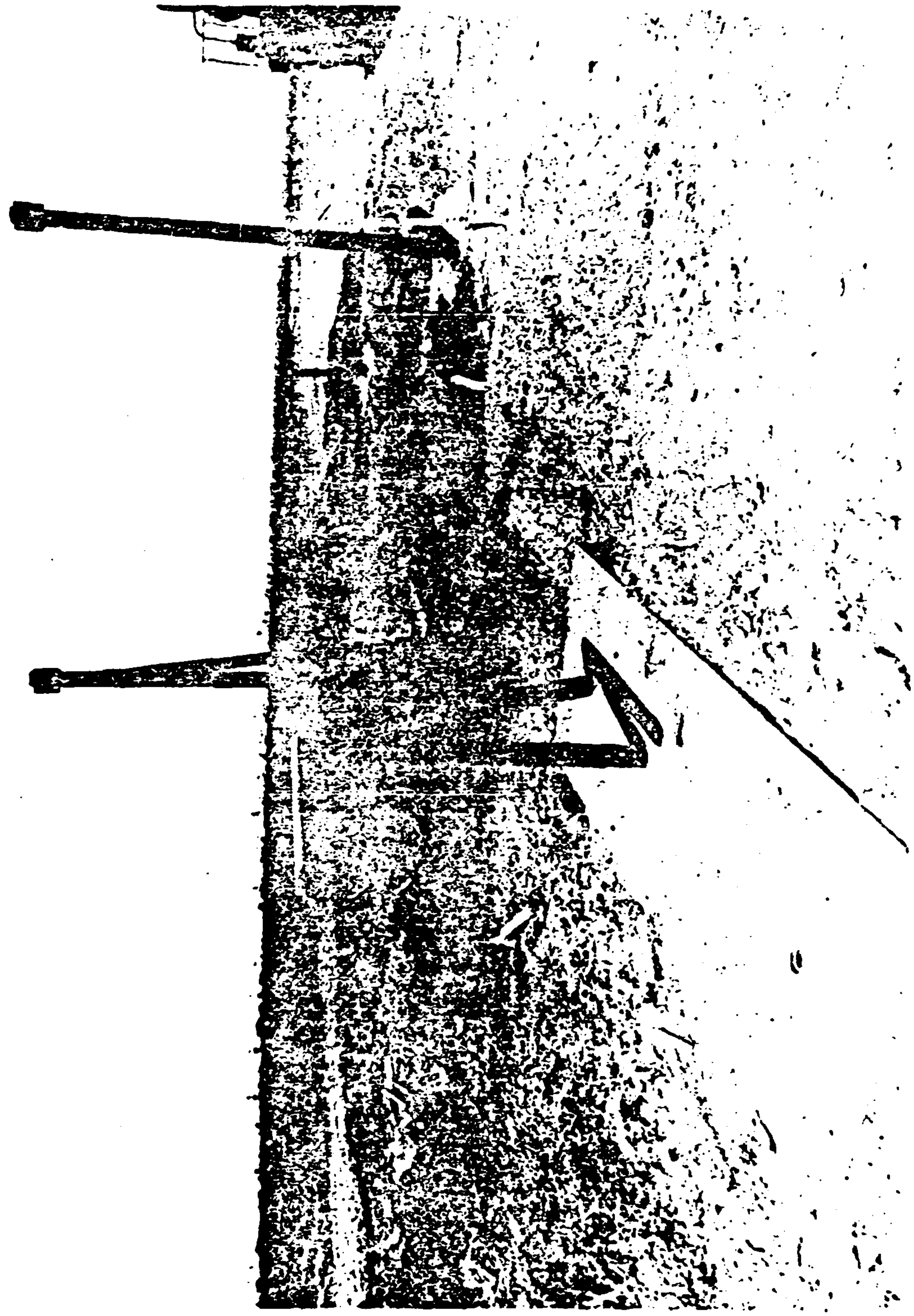

Figure 4-6. Airblast gage (DNA 9901).

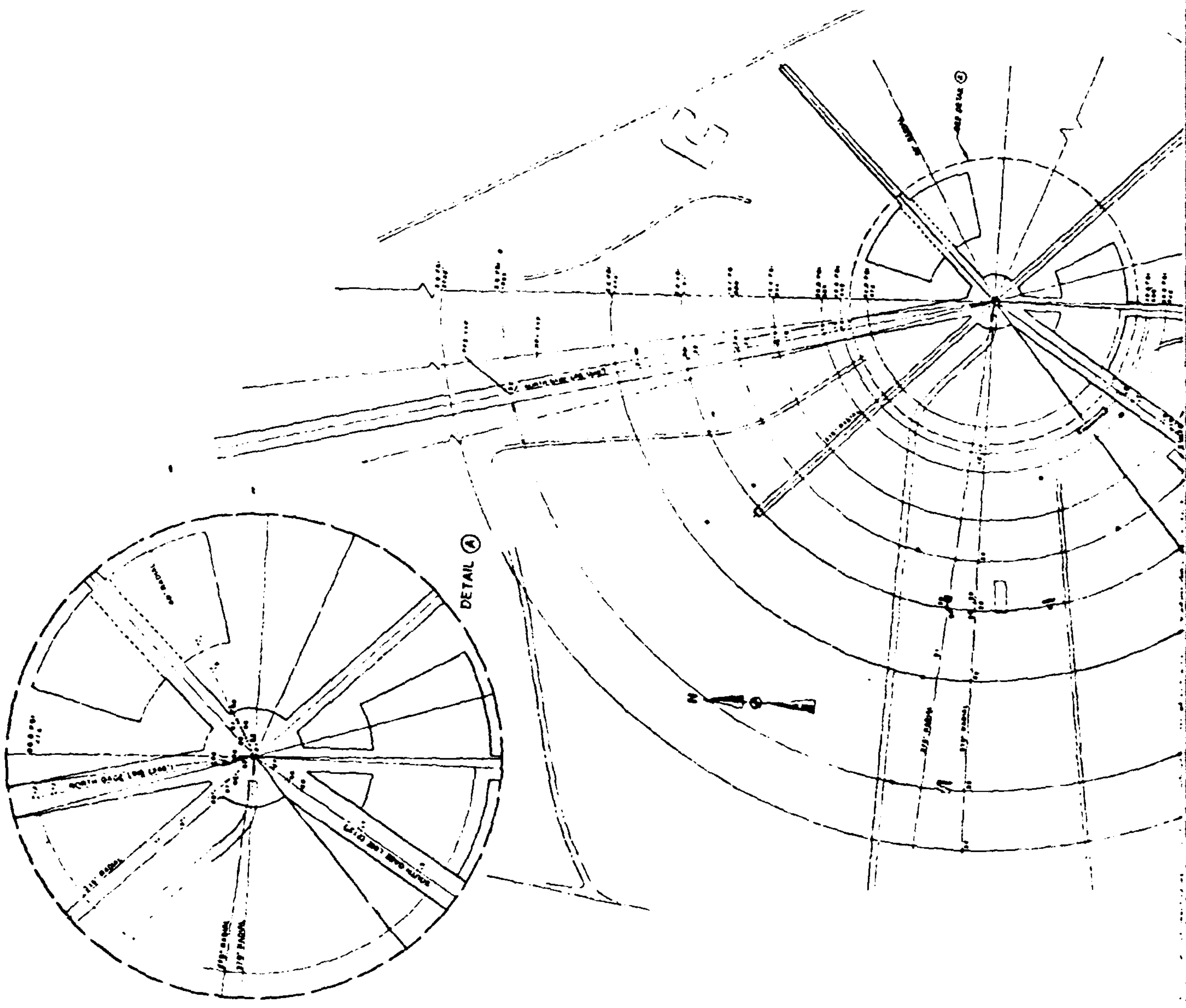

Figure 4-7. Location of t

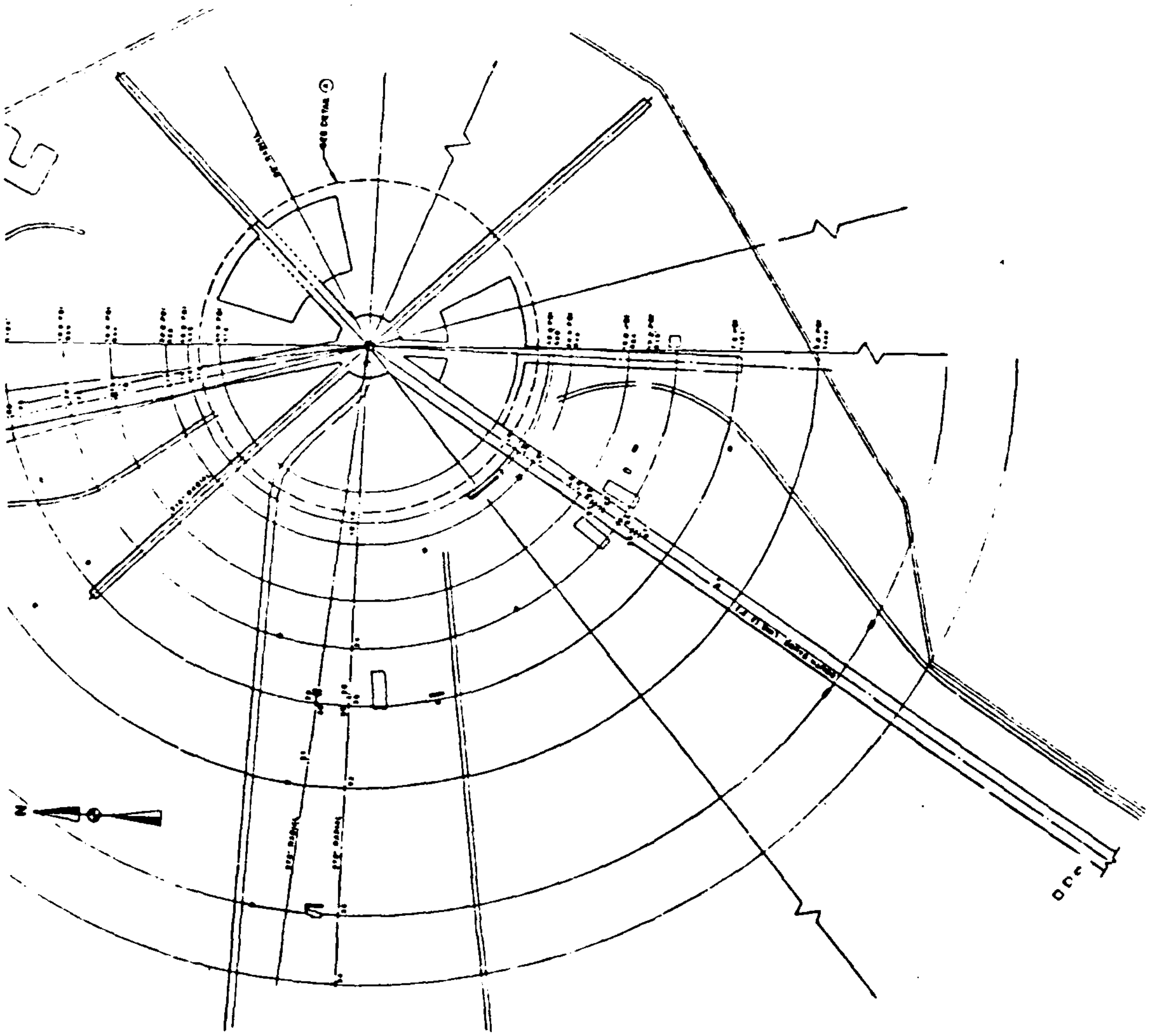

Figure 4-7. Location of free field airblast gages.

4-1.3 Seismic Source Characterization (4401).

These investigations were sponsored by the Defense Advanced Research Projects Agency (DARPA) and fielded by AFWL.

OBJECTIVE: Develop a source characterization of aboveground explosions for comparison to underground sources to predict for military systems long period ground motions from aboveground explosions.

DESCRIPTION: Nine seismic sensors were buried at varying distances between 1.24 miles (2 km) and 6.2 miles (10 km) from GZ to record the ground motions.

4-1.4 Negative Phase Airblast (4101).

This experiment was sponsored by DNA and fielded by AFWL.

OBJECTIVE: Accurately measure the negative phase of airblast in order to investigate its relationship to crater-induced spall.

DESCRIPTION: [redacted] Location of the gages is shown in Figure 4-2. A photo of the gage installed is shown in Figure 4-8.

4-1.5 Airblast Extinction of Fires (5501, 5502, 5503).

This experiment was sponsored by the Federal Emergency Management Agency (FEMA) and fielded by Stanford Research Institute International (SRII) and Los Alamos Technical Associates (LATA). DNA (b)(3)

OBJECTIVE: Investigate possible extinction of fires by the airblast wave.

DESCRIPTION: A total of 15 debris trays were located either at grade level or four feet (1.22 meters) above grade at three overpressure levels: 7.5, 7.0, and 3.5 psi (51.7, 48.3, and 24.1 kPa) at distances of 4.9 to 19.7 feet (1.5 to 6 meters) from a TRS nozzle. There were five trays at each level and each tray was two square feet in area. The Class A fuel in the debris trays was to be ignited by the TRS used for other experimenters. [redacted] Two technical cameras, one for thermal effects and one for blast effects, covered each of the three sets of arrays. The camera coverage is shown in Figures 3-50, 3-51, and 3-52.

4-1.6 Ionosphere Response (6001, 6101).

This experiment was sponsored by DOE and National Oceanic and Atmospheric Administration (NOAA) and fielded by Los Alamos National Laboratory, Scientific and Engineering Associates (SEA), and SRII.

OBJECTIVE: Measure and record ionospheric response to acoustic shock via phase sounding.

DESCRIPTION: A radio frequency phase sounder and a 40-foot (12.2-meter) telescoping antenna (6001) were located on the testbed adjacent to the Administration Park.

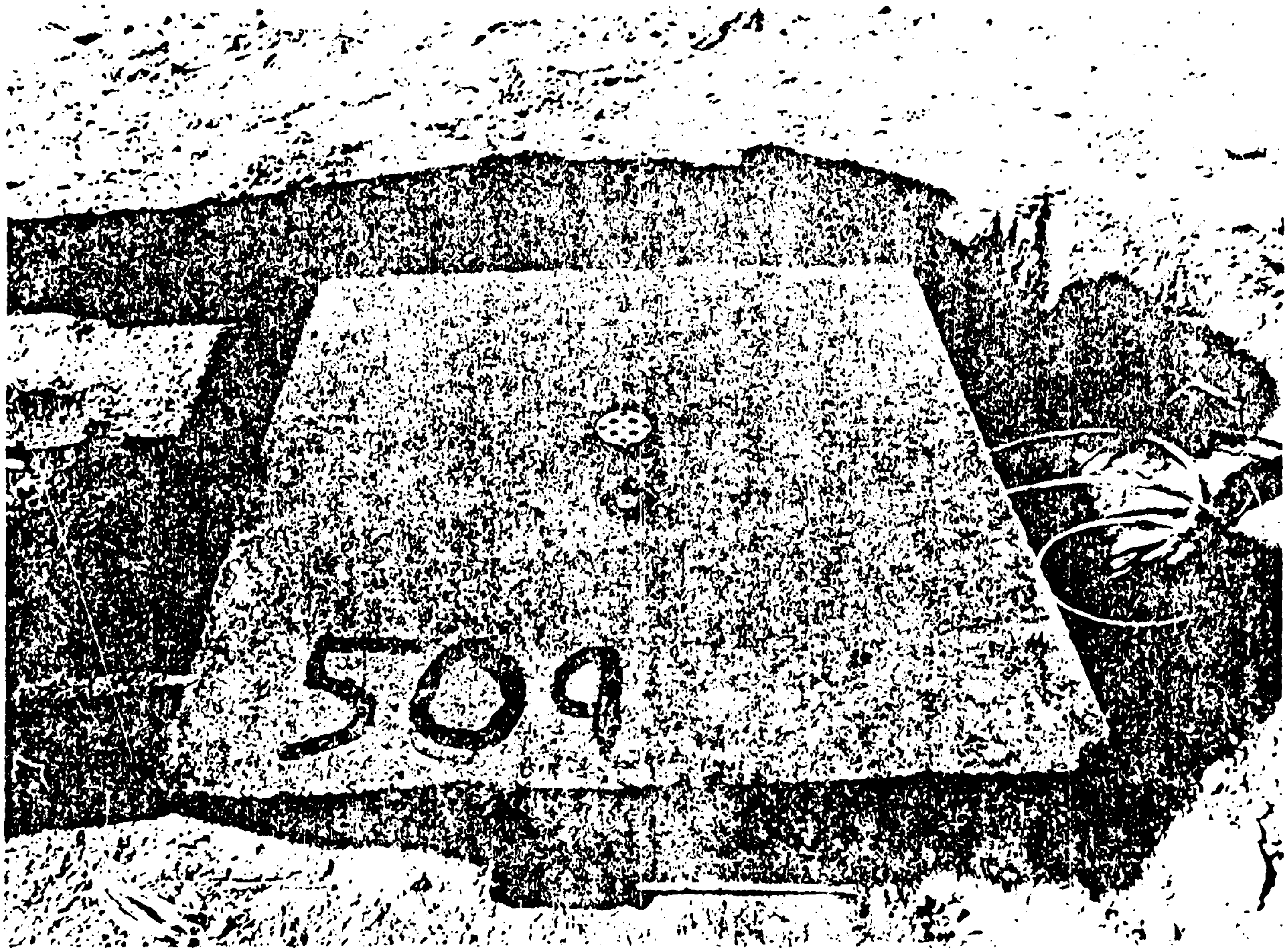

Figure 4-8. Installed negative phase airblast gage (AFWL 4101).

The sounder output was 5 kilowatts of pulsed continuous wave. Four frequencies were used (2.65, 4.0, 5.5, and 8.0 MHz) and the pulse rate was 30 pulses per second (pps). Sounders (6101) were activated at Socorro, NM, and Nellis AFB, Nevada. Backscatter radars (6101) were operated in California and Whitehouse, Virginia. In addition, the California earthquake network was activated to measure the seismic signals.

4-1.7 Magnetic Field Perturbations (6201).

This experiment was sponsored by DOE and fielded by Los Alamos National Laboratory.

OBJECTIVE: Measure and record the magnetic field perturbations due to ionospheric disturbances.

DESCRIPTION: Four self-contained magnetometers with their own power supplies and recorders were fielded at the following locations:

15.5 miles (25 km) northwest of GZ

31 miles (50 km) north of GZ

31 miles (50 km) west of GZ

43.5 miles (70 km) northwest of GZ

4-1.8 Airblast Intercept of Inflight Drones (9301).

This experiment was sponsored by DNA. Experiment design was done by Kaman Airdyne. The drones, instrumentation, and data collection was done by the US Army Test and Evaluation Command, WSMR.

OBJECTIVE: Obtain blast airloads, and structural and aircraft flight response data for a representative inflight aircraft exposed to a long-duration blast wave.

DESCRIPTION: [redacted] In addition, six ground telescope cameras (see Table 3-10) recorded drone take off, landing, and flight over the testbed.

DNA (b)(3)

4-1.9 High Altitude Pressure Measurements (6501).

These measurements were sponsored and fielded by SNLA.

OBJECTIVE: Measure and record incident pressures at altitude.

DESCRIPTION: Four 22 pound (10 kg) flare canisters equipped with parachutes were deployed from a Navy A-7 aircraft. Each canister contained five sensors. The pressure and acceleration-time histories were recorded on the ground via a telemeter link. The first canister was dropped at T-2 minutes from an altitude of 38,000 feet (11.6 km); the other canisters were deployed at 30-second intervals. Altitudes at airblast intercept were to be approximately 26,900, 28,200, 28,900, and 29,500 feet (8,200, 8,600, 8,800, and 9,000 meters, respectively). The slant range from GZ was approximately 60,000, 44,600, 33,500, and 30,200 feet (18,300, 13,600, 10,200, and 9,200 meters, respectively).

4-1.10 Optical and Blast Characterization (7601).

This experiment was sponsored by the United States Air Force (USAF) and fielded by the Air Force Technical Applications Center.

OBJECTIVE: Obtain optical characterization of the ANFO detonation.

DESCRIPTION: The portable equipment used consisted of optical sensors (radiometers), a clock, and a camera all installed in a van. The van was located 27,500 feet (8.382 meters) from ground zero at an elevated position which provided a clear line of sight to the ANFO stack.

4-1.11 High Stress Gage Design (9401).

This experiment was sponsored by DNA and fielded by SRII.

OBJECTIVE: Test the stress gage design concepts to be used for the MISTY JADE test by using the long-duration, high stress shock generated by the detonation of the MILL RACE ANFO stack.

DESCRIPTION: Eight experimental high stress gages were placed in reconstituted soil/grout in depths up to six feet (1.83 meters) directly below the MILL RACE charge. The gages experienced overpressures of 870,000 to 1,450,000 psi (60 to 100 kbar) and durations of 1 to 1.5 milliseconds.

4-1.12 Particle Velocity (9406, 9407).

This experiment was sponsored by DNA and fielded by System, Science and Software (SSS).

OBJECTIVE: Measure particle (soil) velocity using electromagnetic gages being developed for MISTY JADE.

DESCRIPTION: Two electromagnetic gages, each consisting of one field coil [100 turns of magnesium wire wound on a 1-foot (0.3-meter) diameter, 1-inch (0.4-cm) thick magnesium form] carrying 100 amperes supplied by a 1 farad capacitor bank charged to 100 volts, and three pickup (sensor) coils located 1 to 2 feet (0.3 to 0.61 meters) from the field coil were buried in reconstituted sand under the ANFO charge (see Figure 4-9).

4-1.13 [redacted] DNA (b)(3)

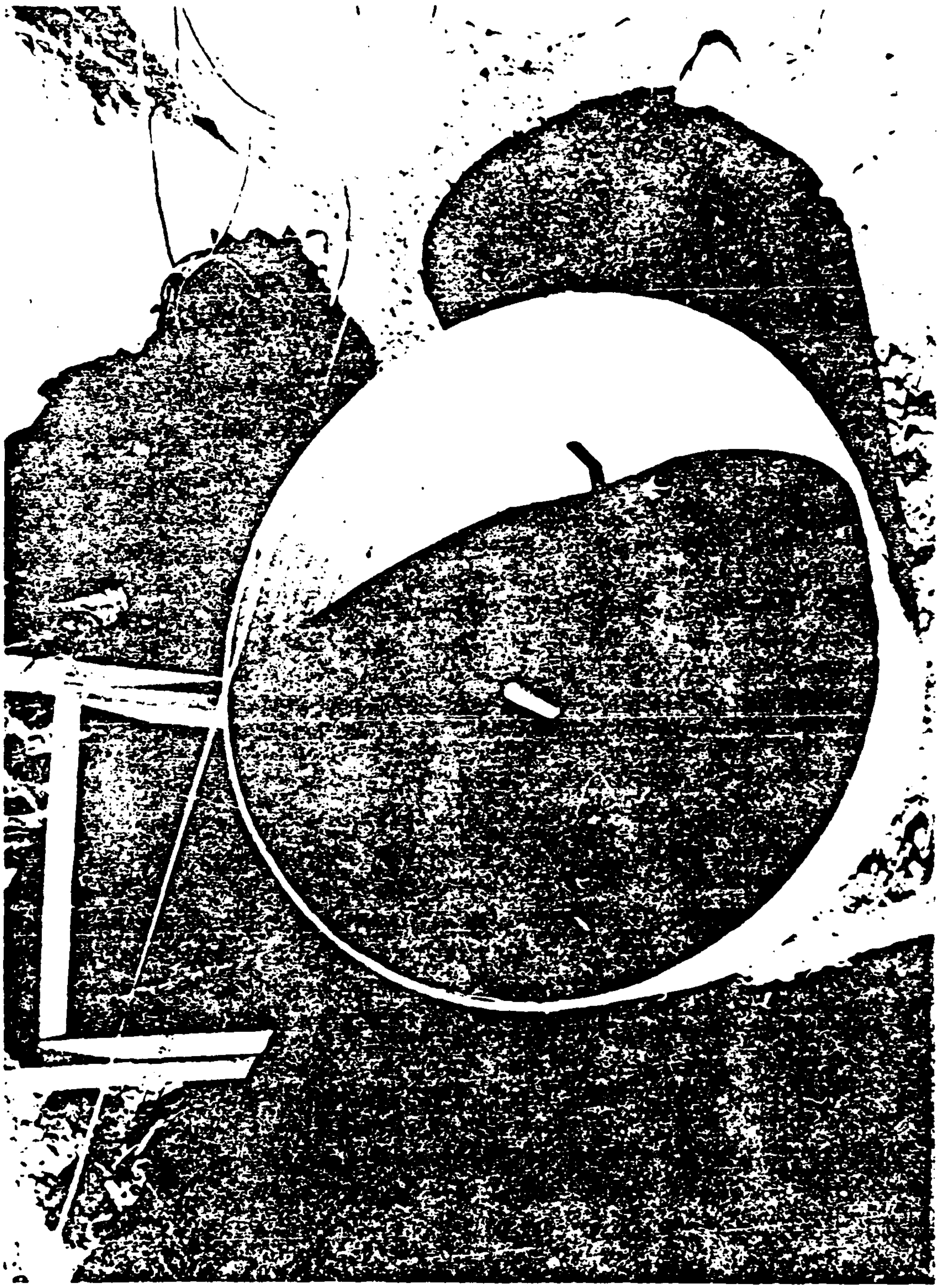

Figure 4-9. Electromagnetic gage.

[redacted]

4-[redacted] Elevated Airblast Measurements (9902).

These measurements were sponsored by DNA and fielded by BRL.

OBJECTIVE: Measure the difference in the overpressure at various heights above the ground surface. Measurements were taken to validate data recorded on Drone A (9301).

DESCRIPTION: At 2.3 psi (15.6 kPa) [2,435 feet (742 meters) from GZ] and in the location where the shock wave would intercept Drone A, two overpressure gages were mounted on telephone poles at 70 feet (21.3 meters) above the ground, two at 35 feet (10.7 meters) and two at 3 feet (0.9 meter).

4-1.15 Elevated Air Flow Measurements (9909).

This experiment was sponsored by DNA and fielded by TRW.

OBJECTIVE: Measure the differences in velocity of air flow near the surface and at distances above the surface to correlate velocity of air flow to dynamic pressure.

DESCRIPTION: Two heated anemometers were co-located with each of the dual gages used for the Elevated Airblast Measurements (9902). Figure 4.10 is a photo on one of the installed anemometers.

4-1.16 CACTUS Coral Stress (9801).

DNA (b)(3)

This experiment was sponsored by DNA and fielded by California Institute of Technology.

OBJECTIVE: Use calibrated samples at the 145,000 psi (10 kbar) and lower levels to compare with CACTUS apparent shock pressure versus distance results. Use samples of heavily saturated shocked coral to measure elastic wave velocity. CACTUS was an 18 kiloton nuclear device detonated 3 feet (0.9 meter) above coral on the island of Runit, Enewetak Atoll, Marshall Islands in May 1958.

DESCRIPTION: Three samples each [11.8 inches (0.3 meter) long] were placed in each of two holes dug below the MILL RACE charge. The top of each sample in borehole #1 was 19.03 feet (5.8 meters), 25.25 feet (8.0 meters), and 32.81 feet (10.0 meters) below the surface. In borehole #2 the samples were 7.56 feet (2.3 meters), 20.67 feet (6.3 meters), and 32.81 feet (10.0 meters) below the surface. (See Figure 4-2.) Borehole #1 was 7.55 feet (2.3 meters) north of GZ and borehole #2 was 7.2 feet (2.2 meters) on a 33° radial from GZ.

4-2 STRUCTURES.

4-2.1 Scale Model Structures Test (4001, 4002, 4003).

This experiment was funded by Air Force Systems Command and fielded by AFWL and the CERF.

[redacted] investigate the valid-[redacted] a semiflexible disturbance in the flow field and stress field of the crater, moving

Figure 4-10. Heated anemometer (DNA 9909).

as a rigid body with the free field. Correlate the theory of a nonuniform stress gradient across the length of a structure with the free field gradient in predicting measurable structural distress.

[redacted]

DNA
(b)(3)

4-2.3 Industrial Steel Frame Buildings (2601, 2602).

This effort was sponsored by the US Army Office of Civil Engineers (OCE) and DNA, and was fielded by WES.

OBJECTIVE: Determine the vulnerability of industrial type buildings from overpressures.

DESCRIPTION: One full-size (2602) and one one-third scale model (2601) steel-frame buildings were exposed side-on to the airblast overpressure. The full-size building was at 10 psi (68.9 kPa) and the model at 6.7 psi (46.2 kPa). The blast impulse on the model was equivalent to that on the full-scale building. The full-size building was 40 feet (12.2 meters) long, 40 feet (12.2 meters) wide, and 30 feet (9.14 meters) high; the model was 13 feet (3.96 meters) long, 13 feet (3.96 meters) wide, and 10 feet (3.05 meters) high. The buildings were instrumented with a total of 56 gages. Three technical cameras documented airblast effects on the full-size building and two cameras on the scaled building. Figures 3-41 and 3-42 show the camera coverage of the two buildings. Figure 4-14 is a photo of the full-size structure prior to detonation. Figure 4-15 is a photo of the same structure after detonation.

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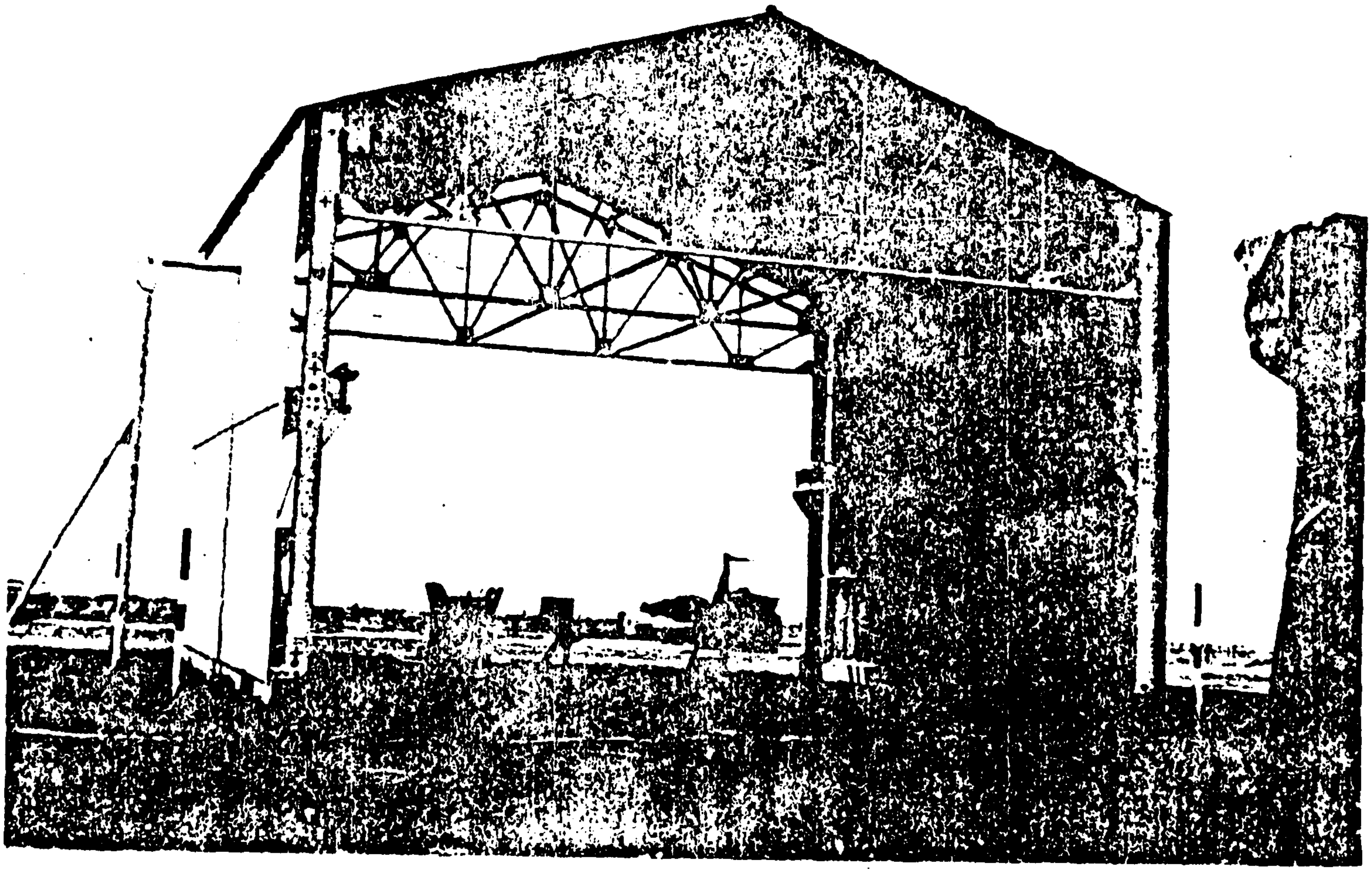

Figure 4-14. Full size steel frame building (preshot) (WES 2602).

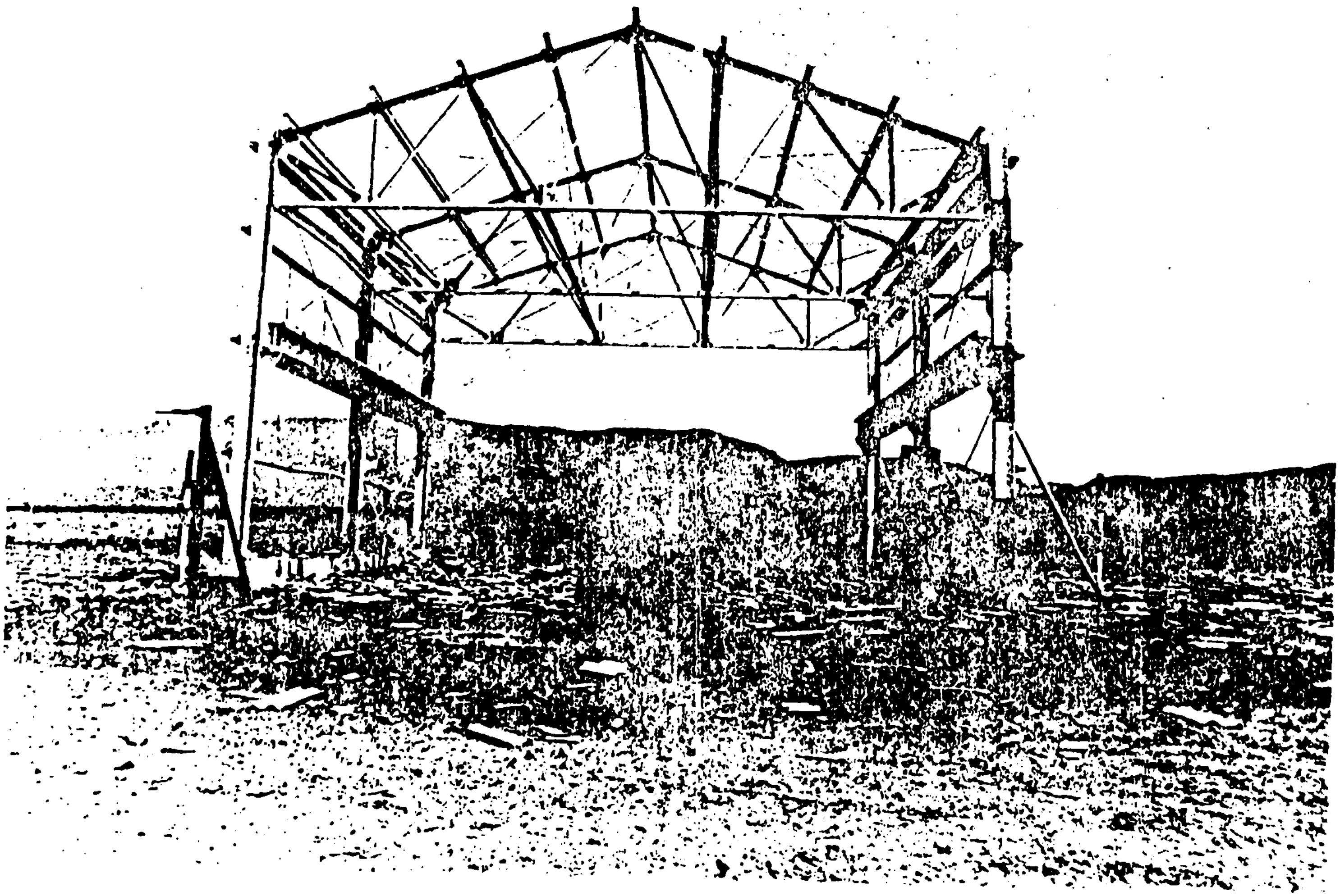

Figure 4-15. Full size steel frame building (postshot) (WES 2602).

4-2.4 Deckhouse Model (3007).

This effort was sponsored by Naval Sea Systems Command (NAVSEA) and fielded by the David Taylor Naval Ship Research and Development Center (DTNSRDC).

OBJECTIVE: Investigate the structural response of a model ship deckhouse exposed to combined thermal and blast effects, and investigate the reaction of various paints to thermal radiation.

[redacted]

4-2.5 Composite Materials (3008).

This experiment was sponsored by NAVSEA and fielded by LATA.

[redacted]

DNA
(b)(3)

4-2.6 Generic Mobile Radars (2075).

[redacted]

4-2.7 Host Area Shelters (5001, 5002, 5003).

This experiment was sponsored by FEMA and fielded by SSI.

OBJECTIVE: Investigate the performance of floor and wall systems, and of closure methods and slabs on grade when exposed to an overpressure.

DESCRIPTION: Three 24-foot (7.32-meter) long by 15-foot (4.88-meter) wide one-story buildings were exposed at the 2 psi (13.8 kPa) level. All three buildings were on a 4-inch (10.26-cm) concrete slab. When completed 5001 and 5002 were on grade, were surrounded by earth berms, and had 18 inches (45.7 cm) of earth on the roof. Each building had normal interior partitions with openings for conventional windows, doors, ventilation,

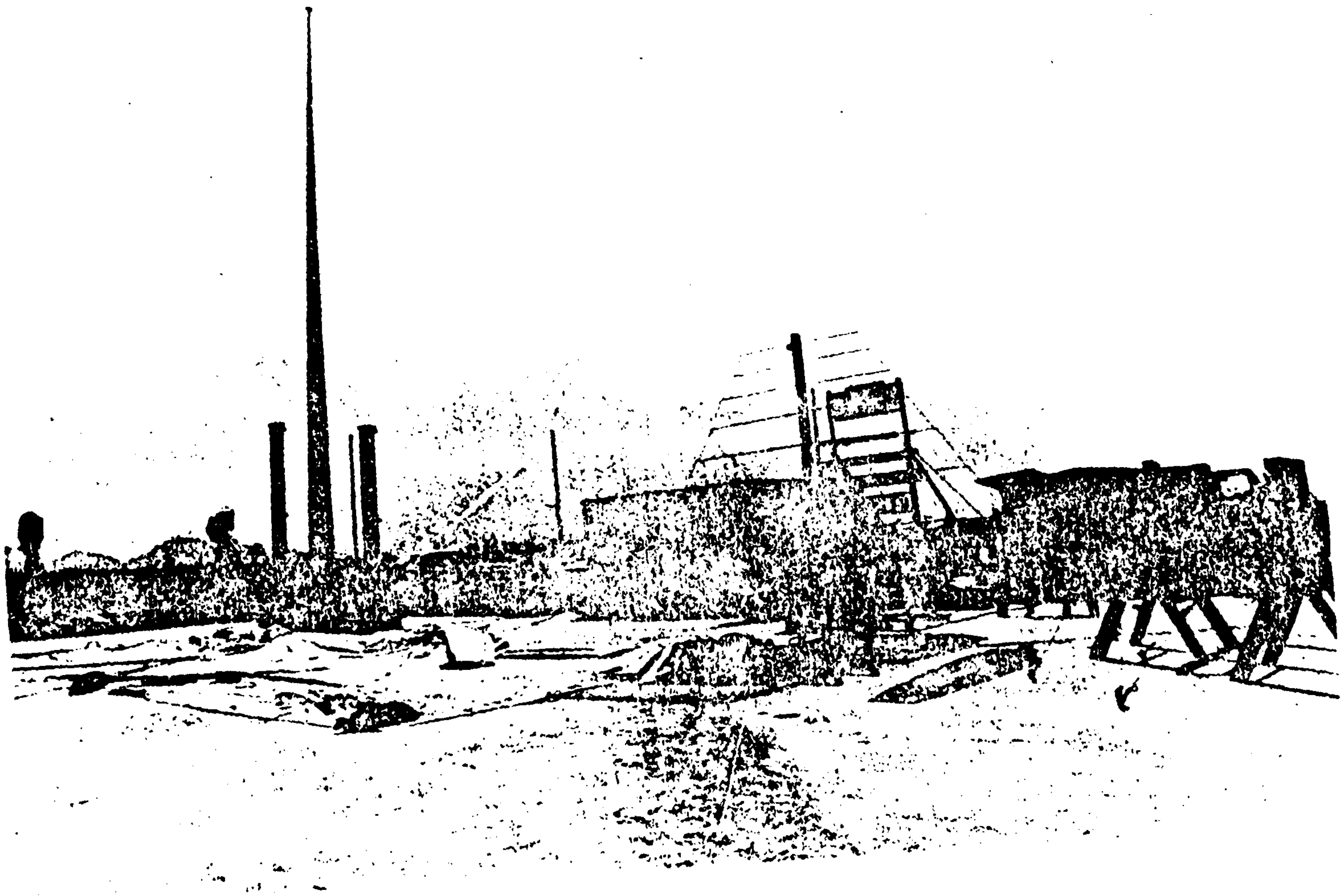

Figure 4-16. Navy experiments including deckhouse, composite materials, and antennas (NAVSEA 3001, 3002, 3003, 3005, 3007, 3008).

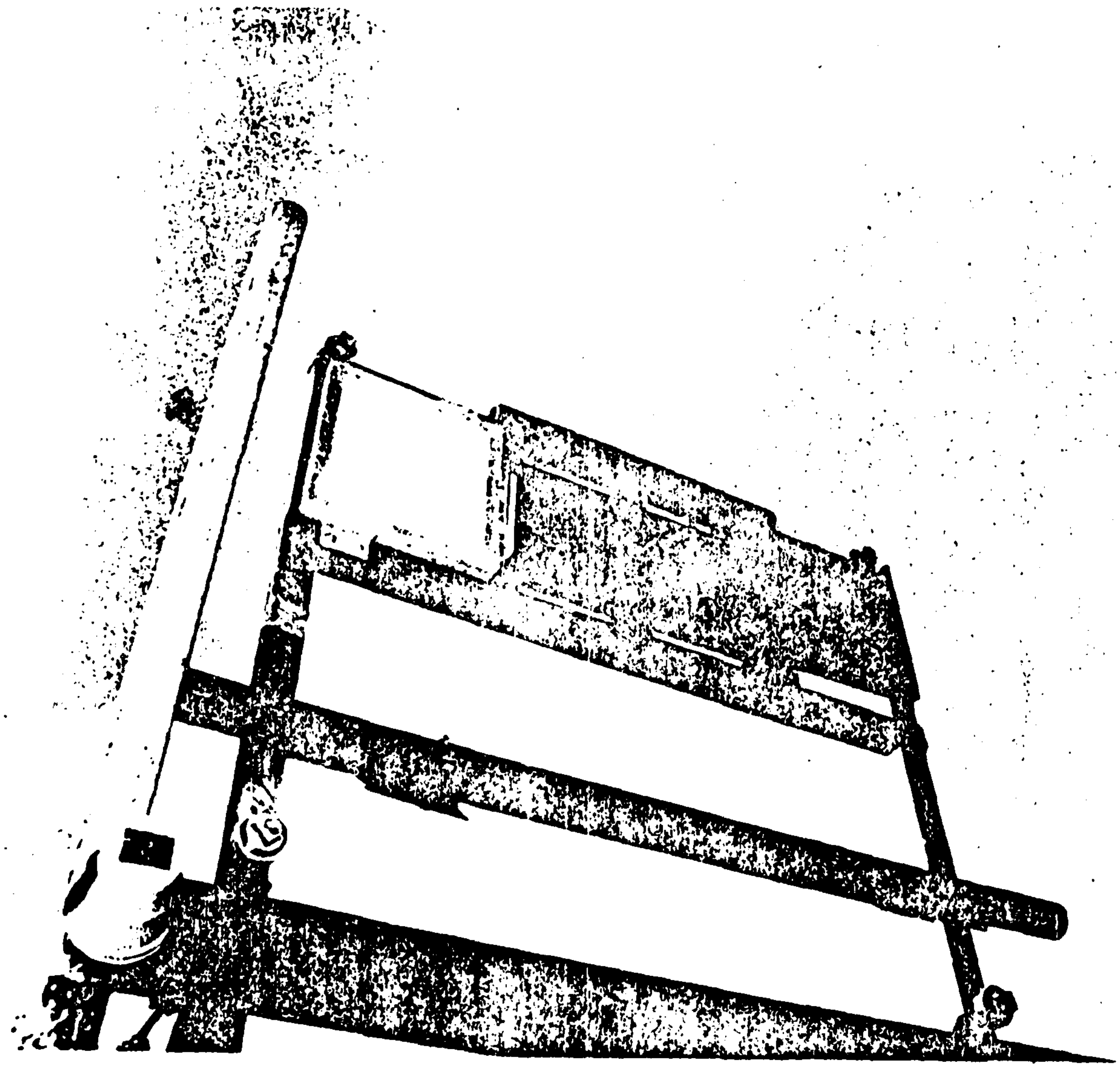

Figure 4-17. Composite materials (NAVSEA 3008).

and air conditioners and vertical and horizontal openings for plumbing, drains, etc. Experiment 5001 had a wooden joist ceiling and wooden stud walls on all four sides. Experiment 5002 had a roof of 4-inch (10.2-cm) precast concrete slabs and four walls composed of one-half brick and one-half concrete blocks. Experiment 5003 was a basement with a wooden joist floor and ceiling and four walls made of brick. Experiments 5001 and 5002 had earth berms against the interior walls while 5003 used wooden shoring. Experiment 5003 had one technical camera providing internal coverage of the ground motion effects on the walls, ceiling, and floor of the building. Figure 3-45 shows the camera coverage. Figures 4-18, 4-19, and 4-20 show the brick/concrete block building and the wooden building during construction.

4-2.8 Industrial Hardening (5101, 5102, 5103).

This experiment was sponsored by FEMA and fielded by SSI.

OBJECTIVE: Evaluate (1) buried vaults as nonengineered shelter structures, (5101, 5102), (2) anchoring of equipment (5103) to determine anchor effectiveness, and (3) various methods of hardening industrial equipment (5103).

DESCRIPTION: For (1) above, two utility vaults were buried beneath 3 feet (0.91 meters) of earth at 20 psi (5101) and 40 psi (5102) (137 and 275 kPa) overpressure. For (2), several types of anchoring systems were used to secure barrels and various types of shop equipment. For (3), 14 identical pieces of industrial shop equipment were exposed to 20 psi (137 kPa). Two pieces were unhardened and two each were hardened with six different methods, i.e., with berms, trenches, tiedowns, sandbags, filled-in holes and filled in trenches. Figure 4-21 is a photo of trench-hardened equipment prior to detonation. Figure 4-22 is the same equipment after detonation.

4-2.9 Key Worker Shelters (5201).

This experiment was sponsored by FEMA and fielded by SSI.

OBJECTIVE: Evaluate various types of construction techniques used for hardening worker shelters against airblast at 40 psi (275 kPa) level in three areas: (1) basement walls, (2) shoring methods for first floor, and (3) punching shear on 4-inch (10.2-cm) slab on grade.

DESCRIPTION: One basement structure of an industrial-type building 144 feet (43.9 meters) long and 16 feet (4.88 meters) deep with the long side normal to GZ was divided into four bay areas [Area 1 was 48 feet (14.6 meters) long, and Areas 2, 3, and 4 were each 32 feet (9.7 meters) long]. See Figure 4-23. The perimeter walls for Areas 1, 2, 3, and for the back of Area 4 and the walls separating each area were constructed of non-failing concrete. The deck (roof of the structure) was two-way cast-in-place concrete with Areas 1, 2, and 4 upgraded to 40 psi (275 kPa) by wooden shoring. Area 3 was upgraded to 15 psi (103 kPa). All four areas had the deck slab supported by a beam/column frame. Walls were constructed of block, brick, or cast-in-place concrete. Certain sections were designed to fail. The entire structure was covered with 18 inches (45.7 cm) of earth on

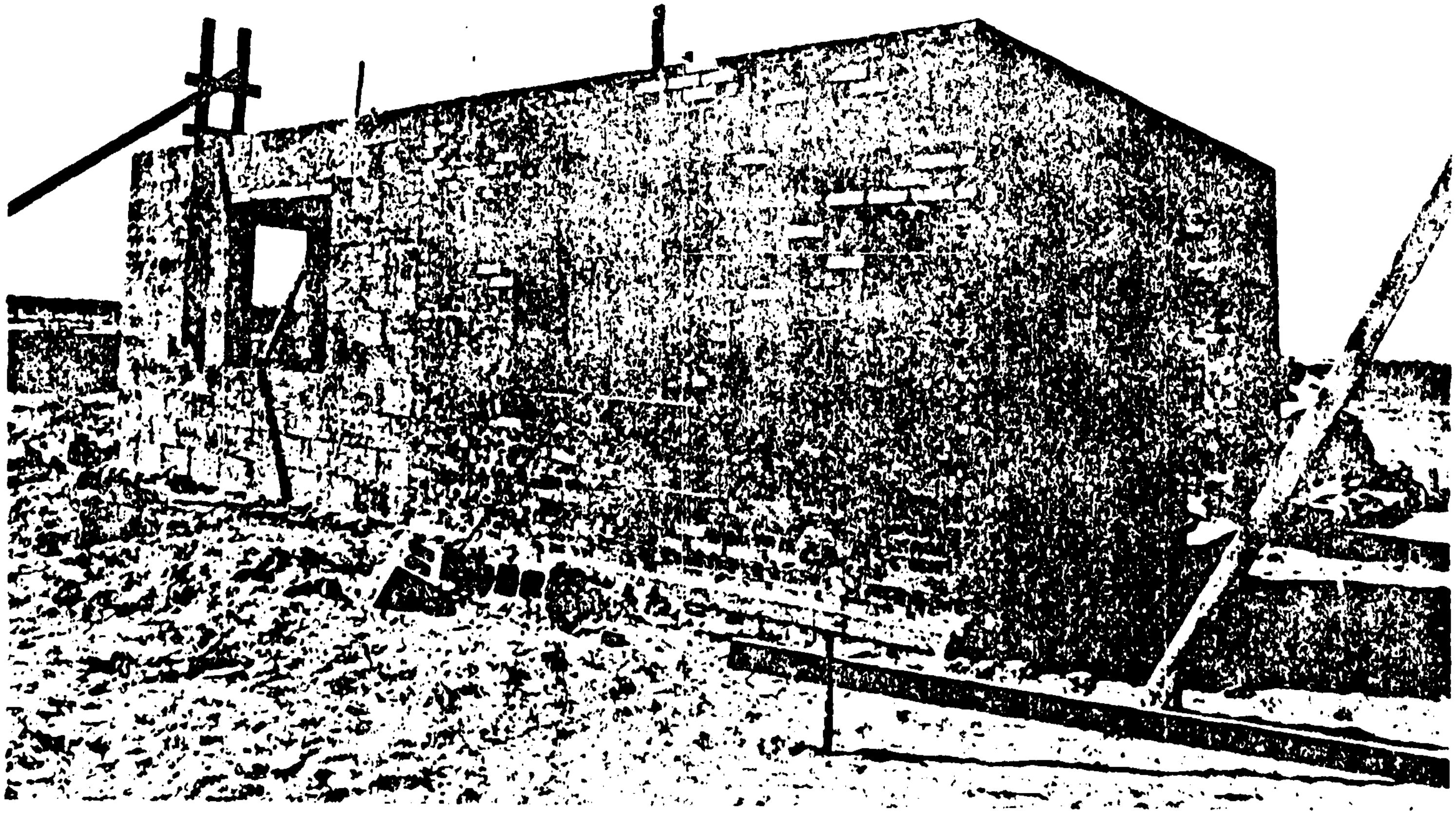

Figure 4-18. Brick/concrete block building (external view) (FEMA 5002).

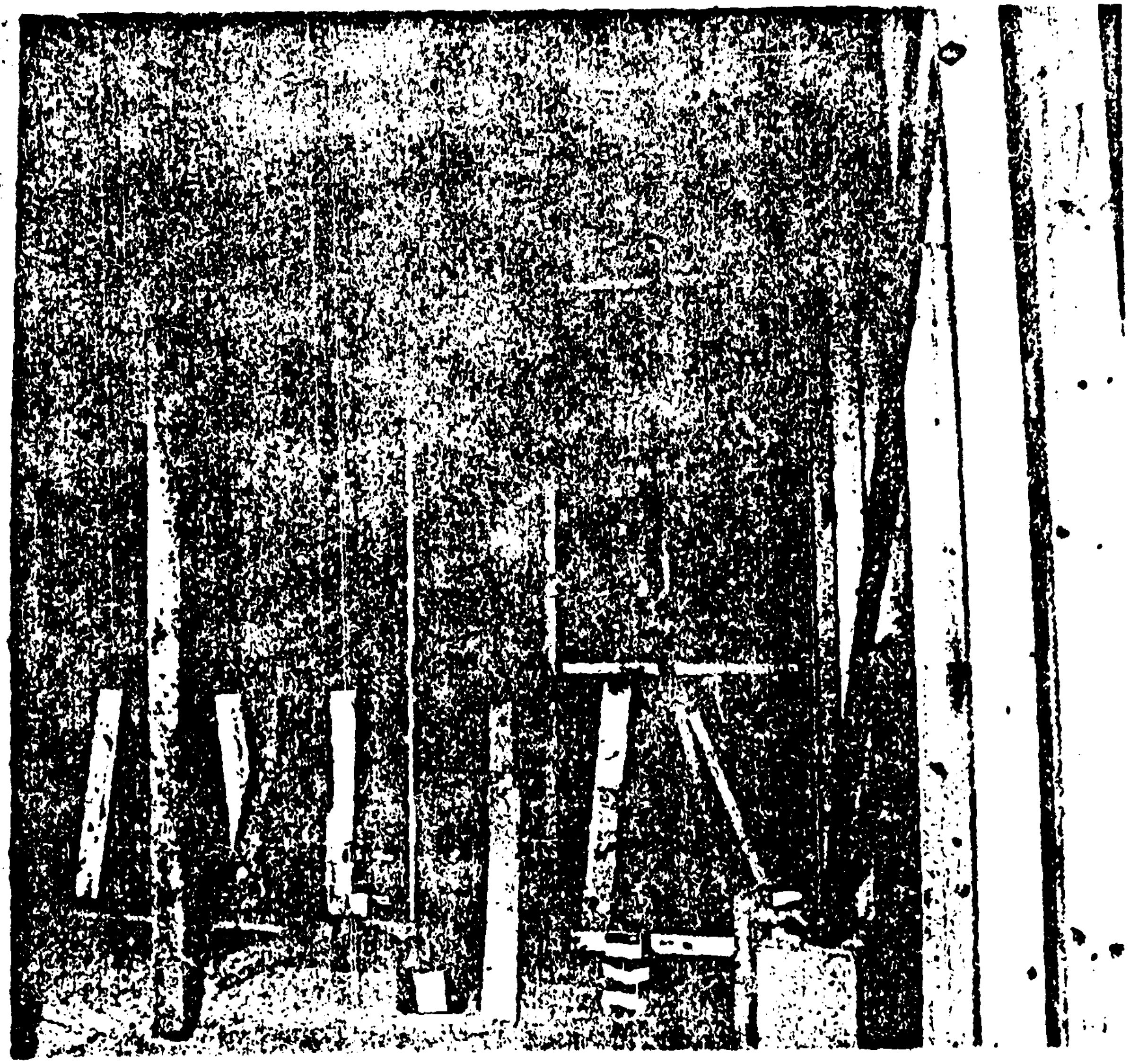

Figure 4-19. Brick/concrete block building (internal view) (FEMA 5002).

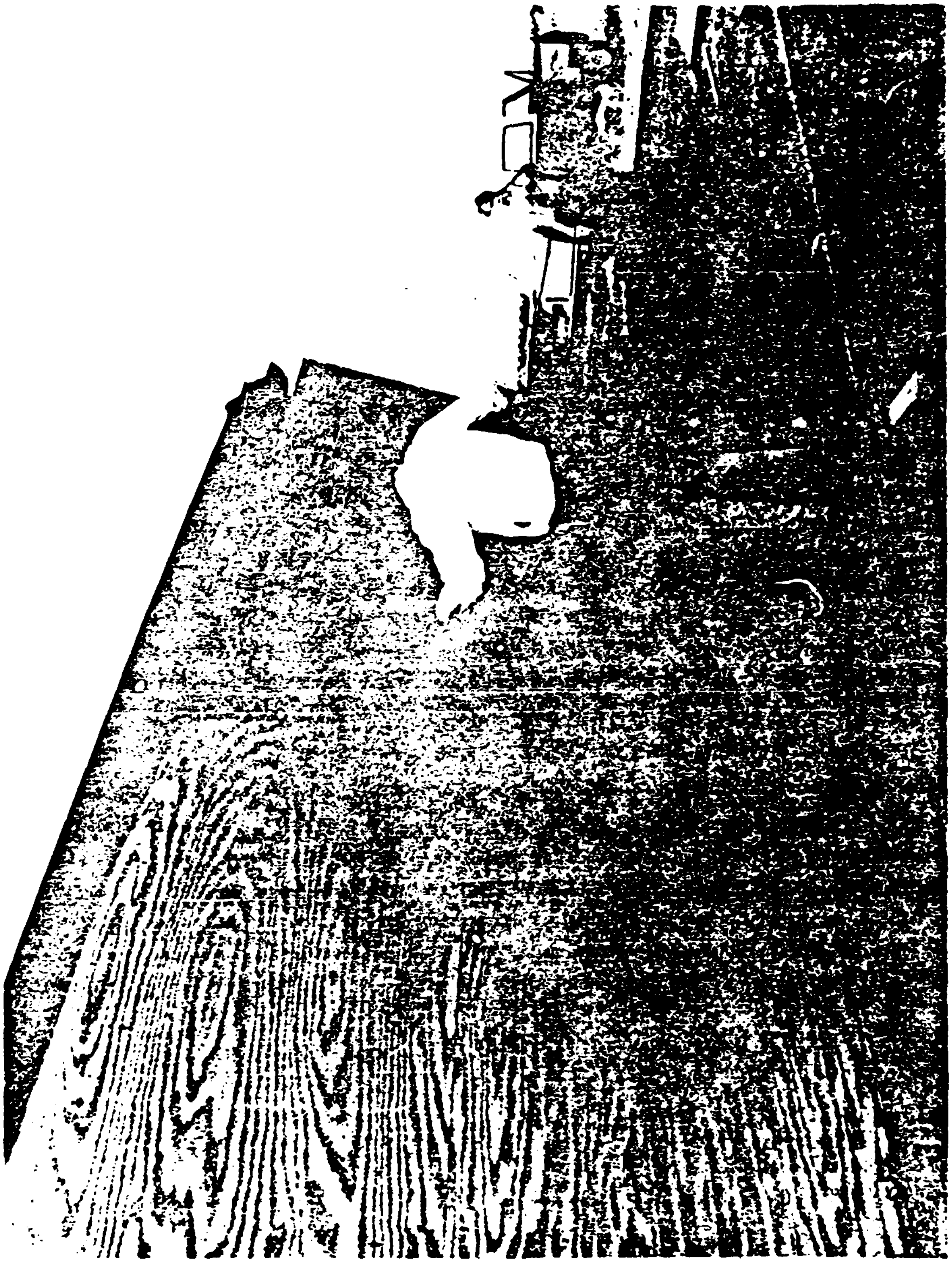

Figure 4-20. Wooden frame buildiig (FEMA 5001).

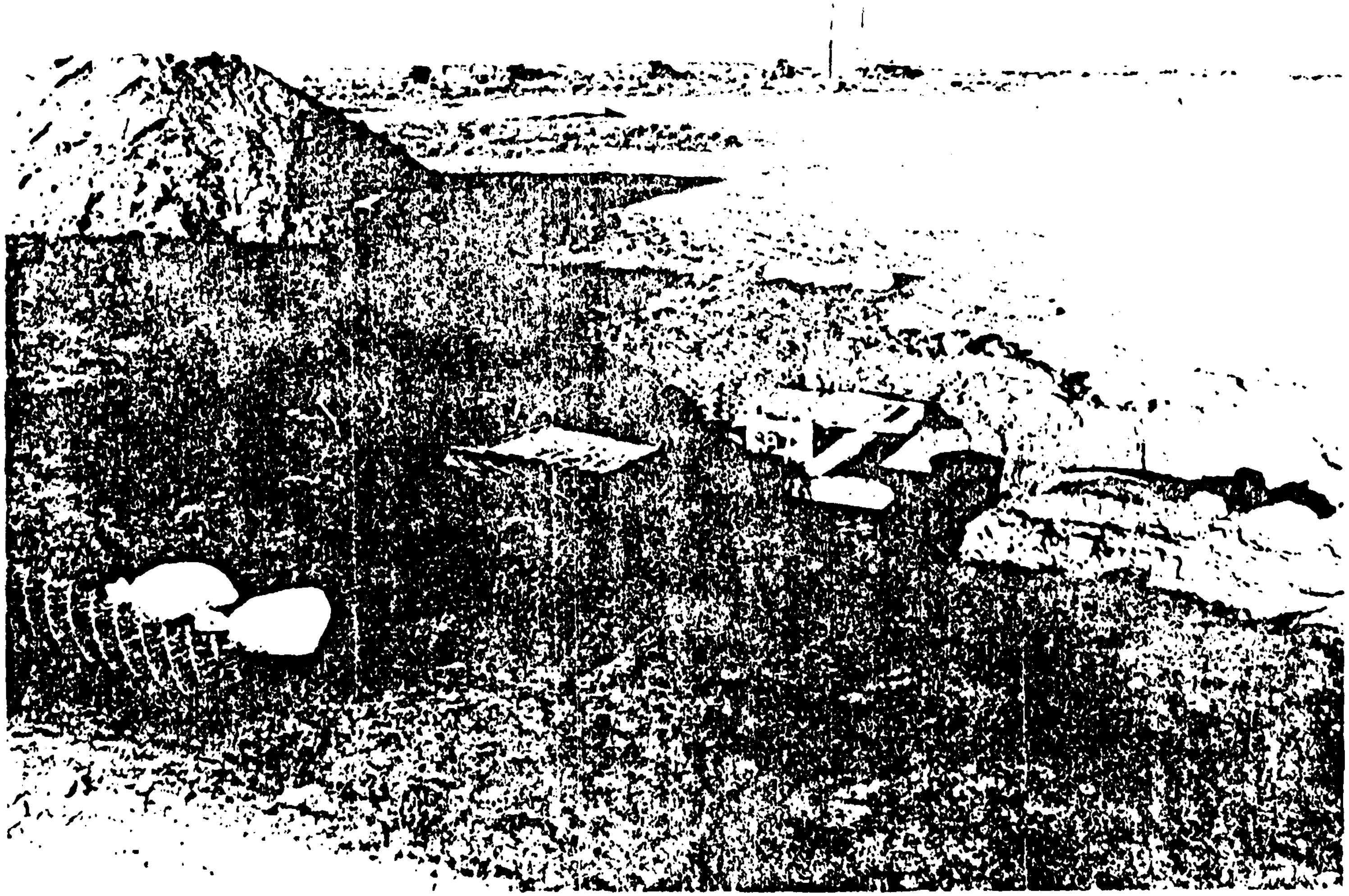

Figure 4-21. Trench-hardened industrial equipment (preshot) (FEMA 5103).

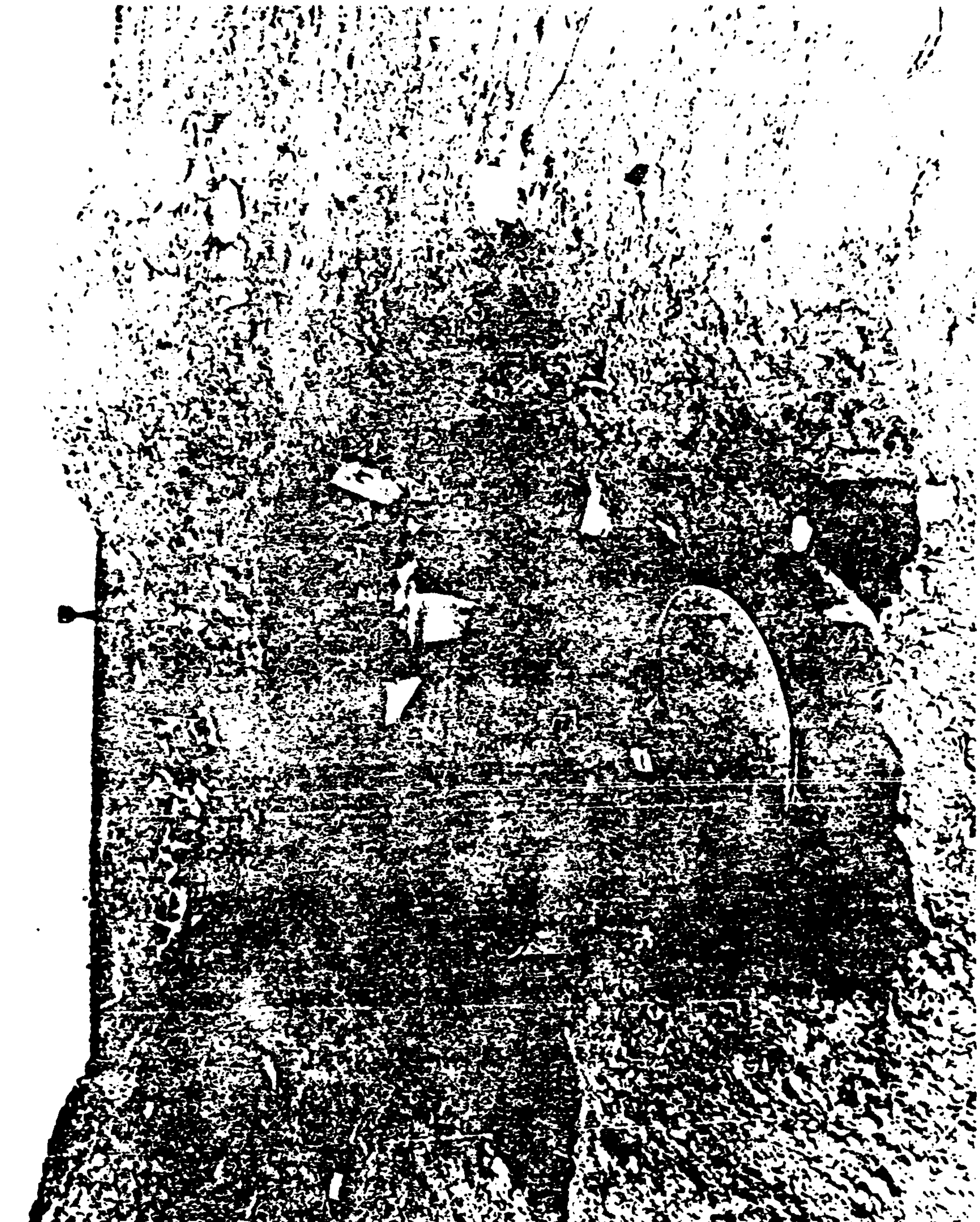

Figure 4-22. Trench-hardened industrial equipment (postshot) (FEMA 5103).

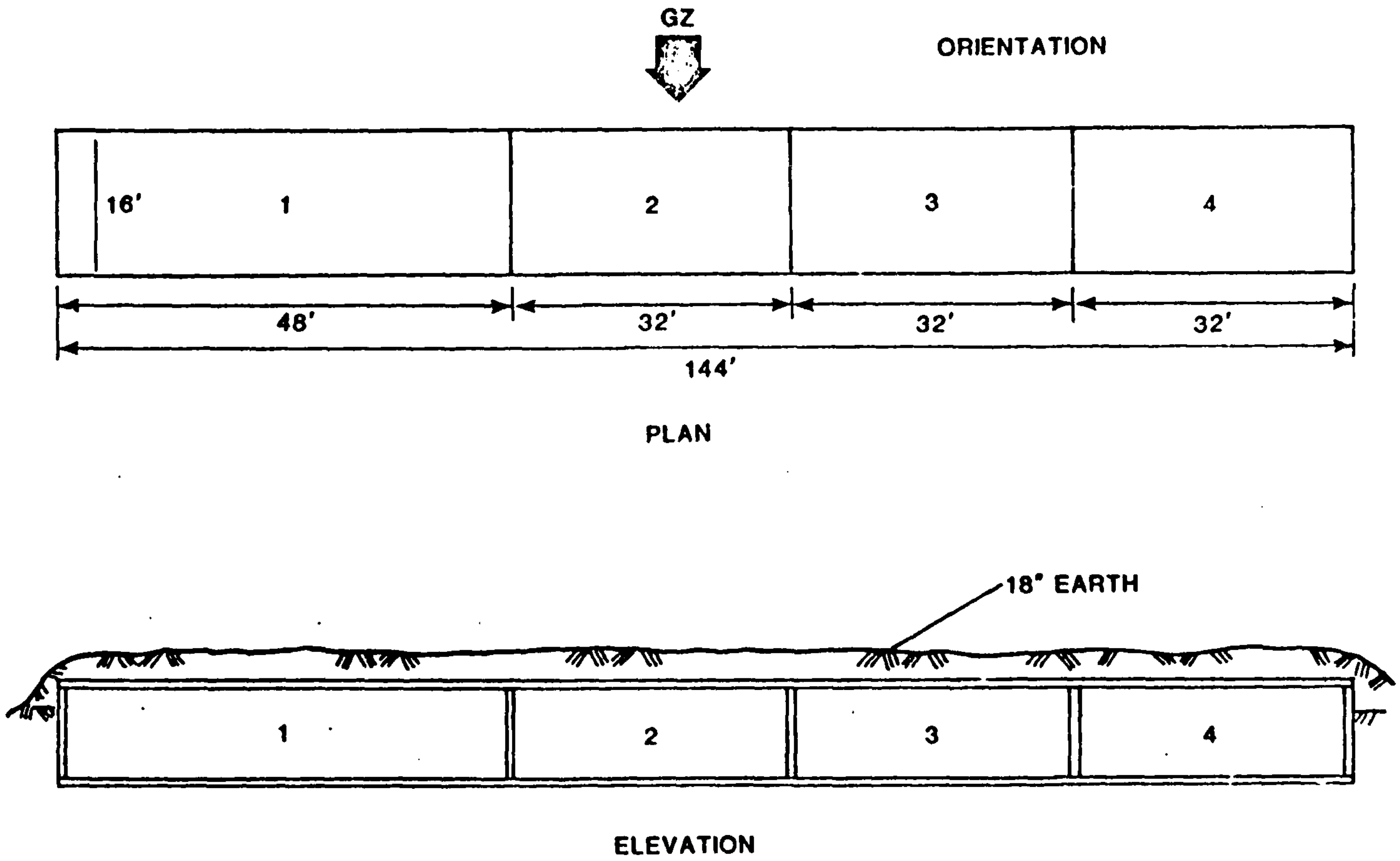

Figure 4-23. Key worker shelters (FEMA 5201).

the deck and the perimeter was bermed. There were two technical cameras providing internal coverage, one recording blast effects in Area 1 and one in Area 2. Figure 3-46 shows the camera coverage. Figures 4-24, 4-25, and 4-26 show details of Area 1, Areas 2 and 3, and Area 4. Figure 4-27 is a photo of the structure during construction.

4-2.10 Key Workers Expedient Shelter Test (5301).

This experiment was sponsored by FEMA and fielded by SSI.

OBJECTIVE: Test the lumber version of the Oak Ridge National Laboratory Small Pole Shelter at the 40-psi (275 kPa) level.

DESCRIPTION: A wooden frame building 16 feet (4.88 meters) by 7 feet (2.84 meters) by 10 feet (3.05 meters) was installed below ground and covered with earth.

4-2.11 Debris Dispersal and Structural Response (5401, 5402, 5403).

These experiments were sponsored by FEMA and fielded by SRII.

OBJECTIVE: Evaluate structural response and subsequent debris dispersal of the CMU building.

DESCRIPTION: One building (5402) with reinforced concrete panels 10 feet (3.05 meters) by 10 feet (3.05 meters) by 8 feet (2.42 meters) high was exposed to an airblast environment of 25 psi (172.4 kPa). Two concrete block buildings 16 feet (4.88 meters) by 16 feet (4.88 meters) by 8 feet 8 inches (2.64 meters) high were exposed to airblast pressures of 30 psi (5401) and 10 psi (5403) (206.8 and 68.9 kPa). All roofs were made of reinforced concrete. Three technical cameras were placed on each experiment Two cameras were placed at oblique angles looking at the front and side walls and one camera was at an oblique angle looking at the side and rear walls. Figures 3-47, 3-48, and 3-49 show the camera coverage. Figures 4-28 (5402) and 4-29 (5401 and 5403) are photos of the concrete panel and concrete block buildings, respectively.

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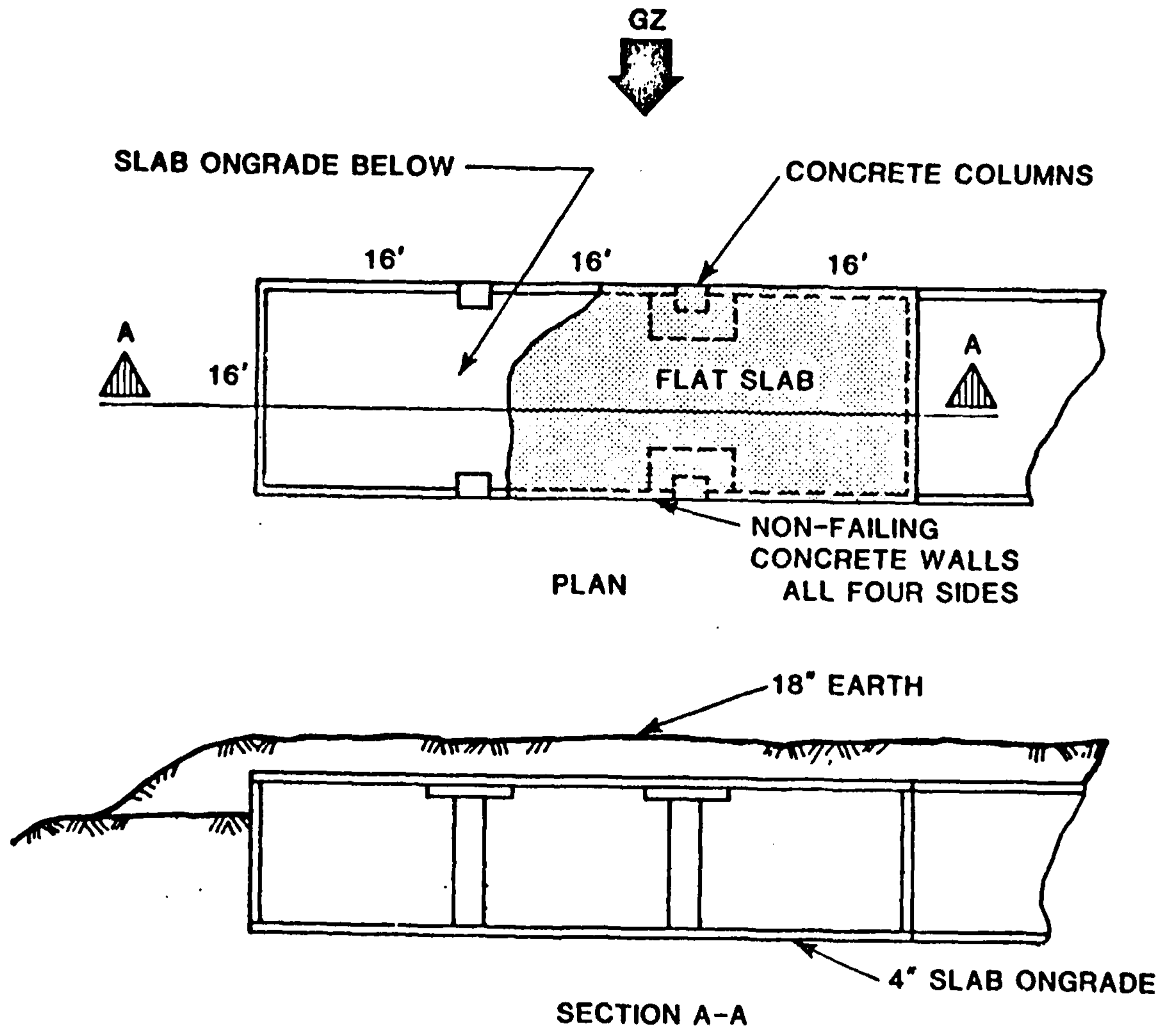

Figure 4-24. Area 1 (FEMA 5201).

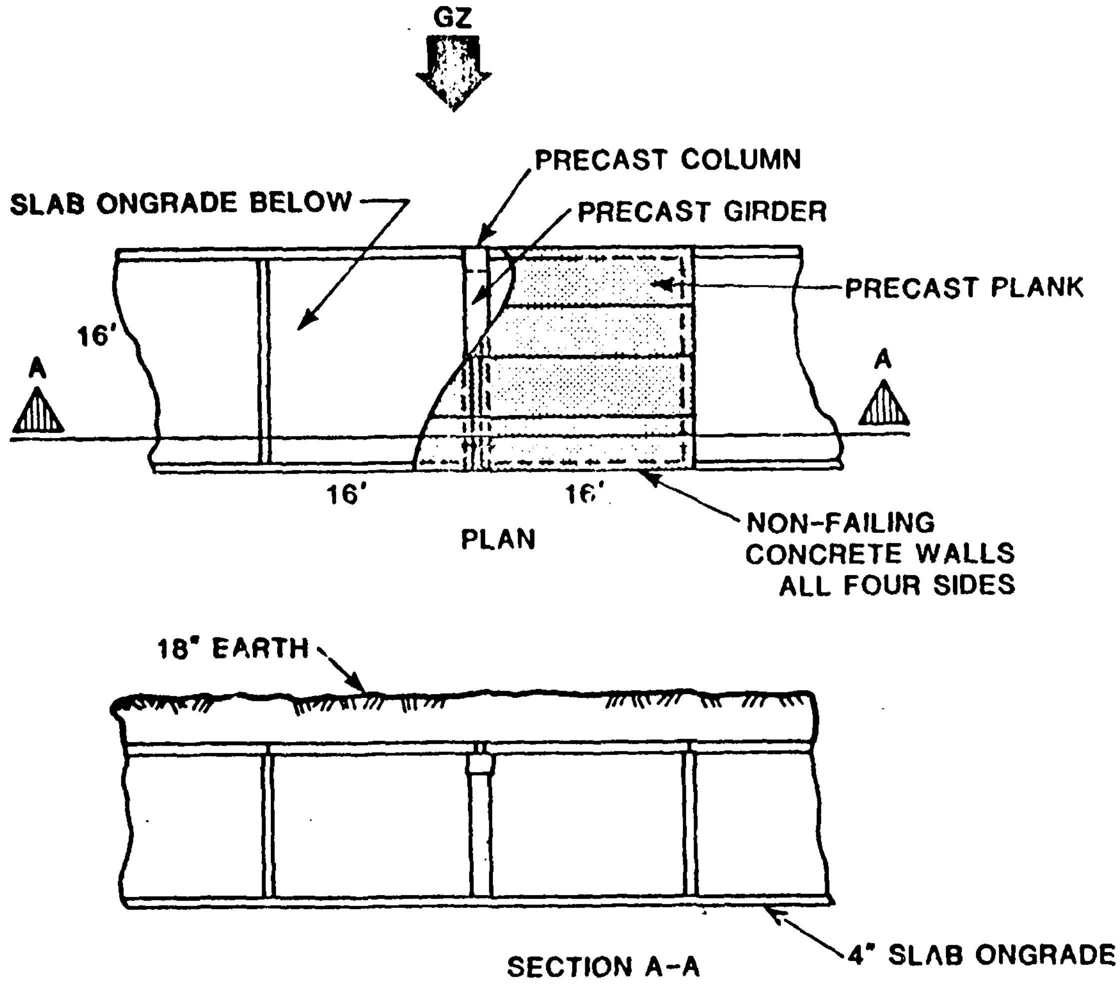

Figure 4-25. Areas 2 and 3 (FEMA 5201).

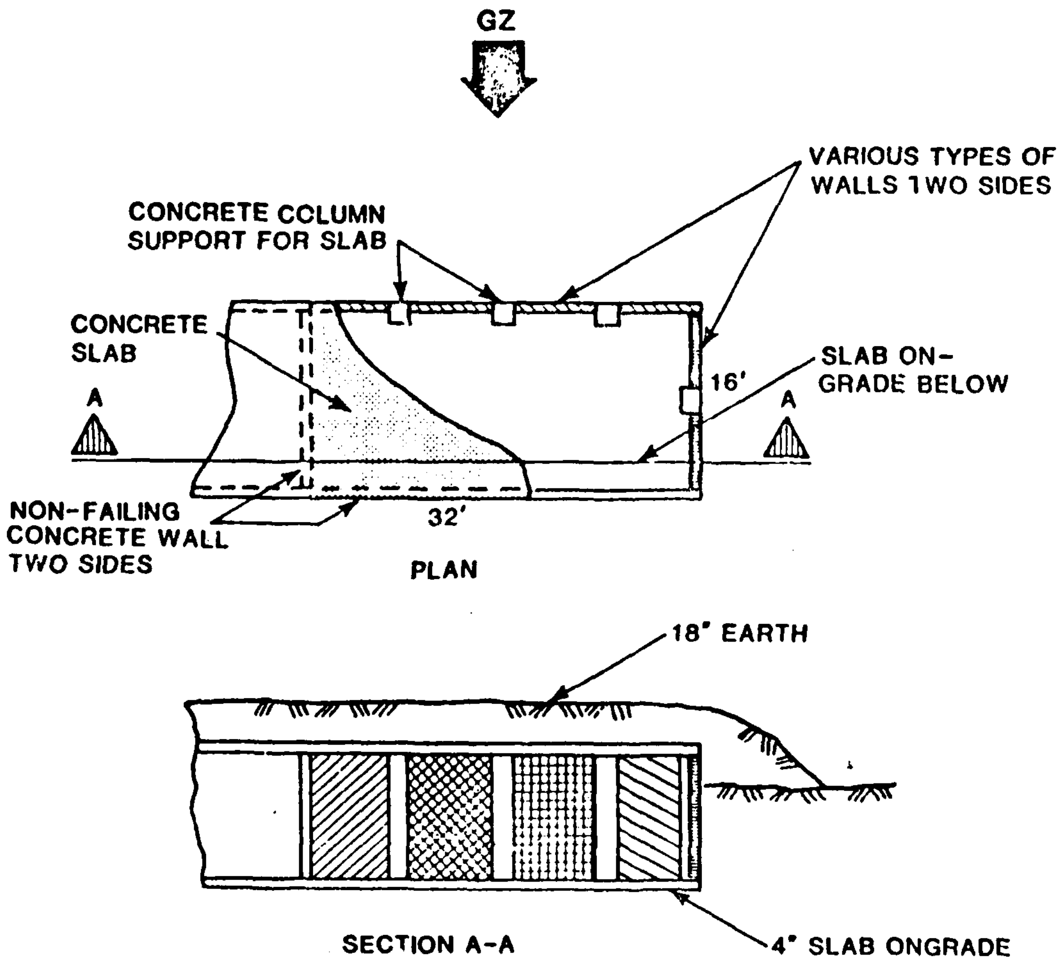

Figure 4-26. Area 4 (FEMA 5201).

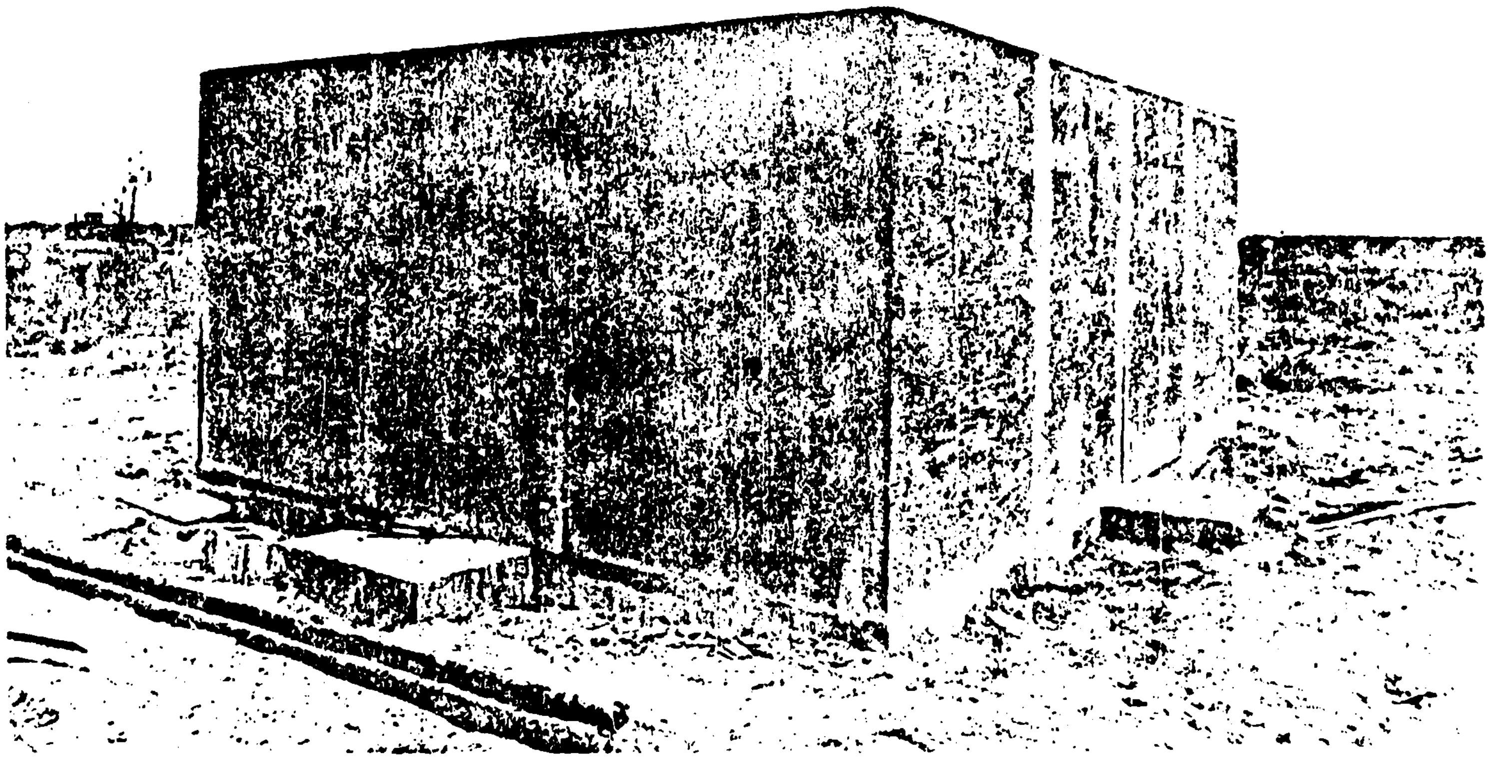

Figure 4-27. Key worker shelter (FEMA 5201).

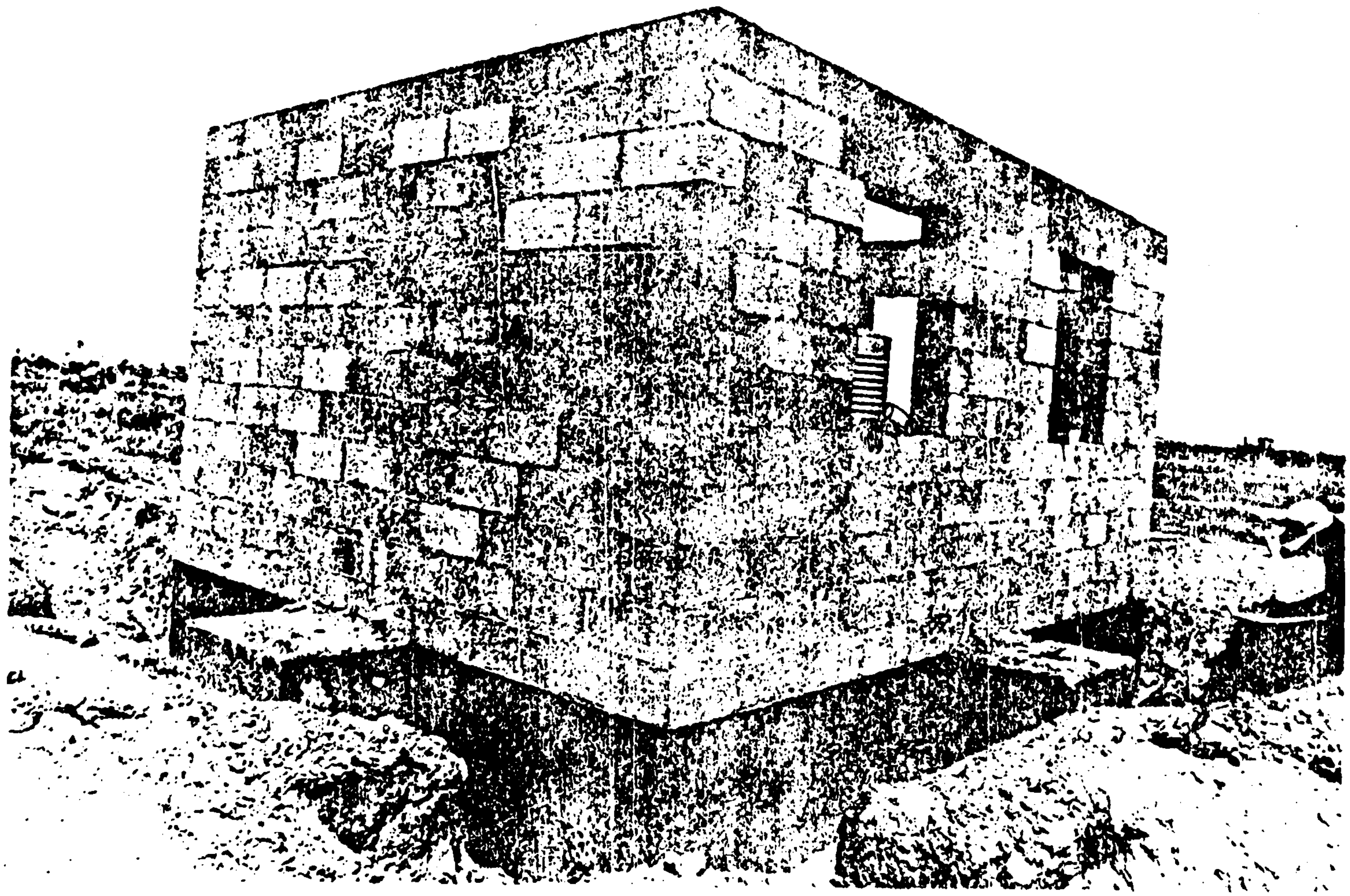

Figure 4-28. Concrete panel building (FEMA 5402).

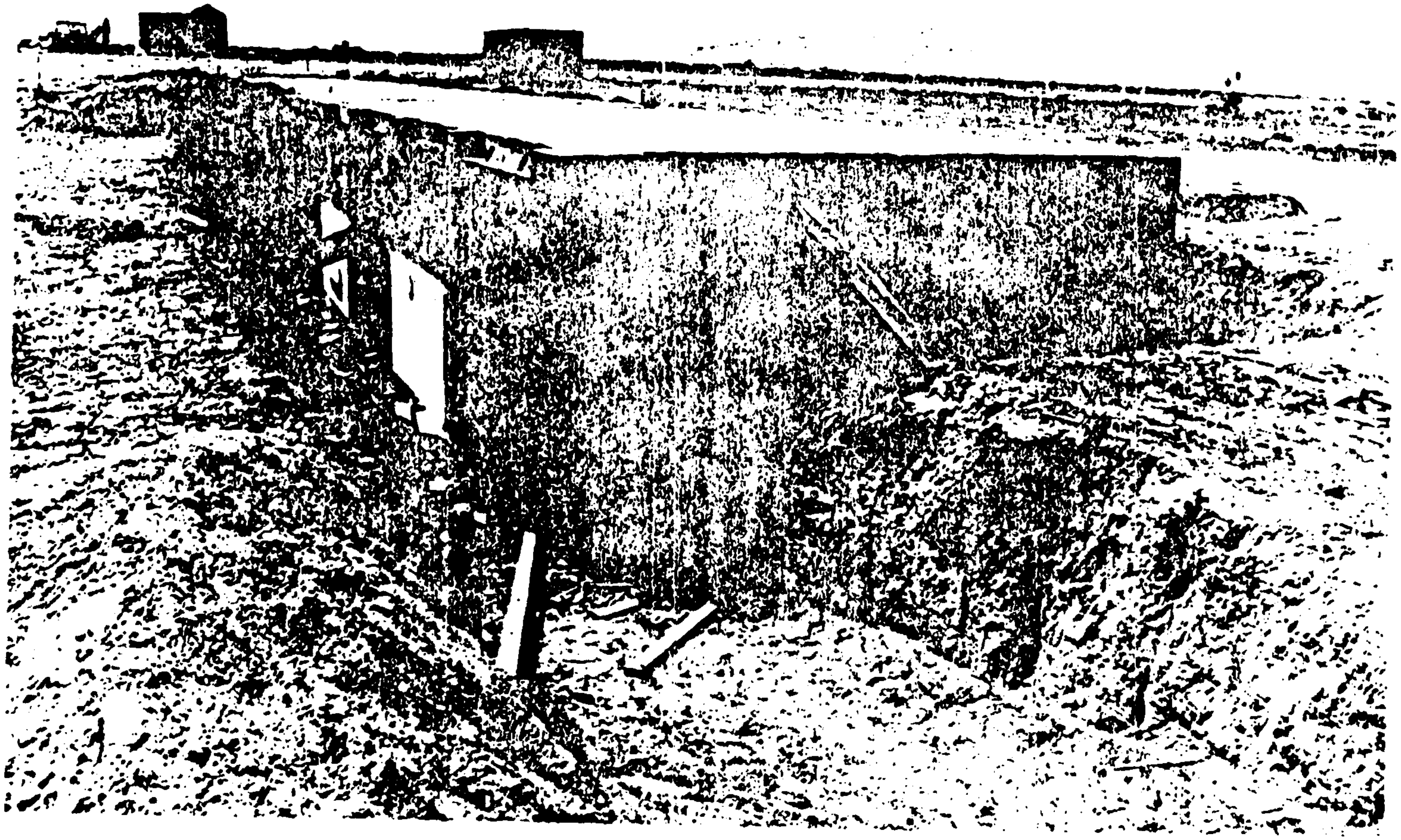

Figure 4-29. Concrete block building (FEMA 5401, 5403).

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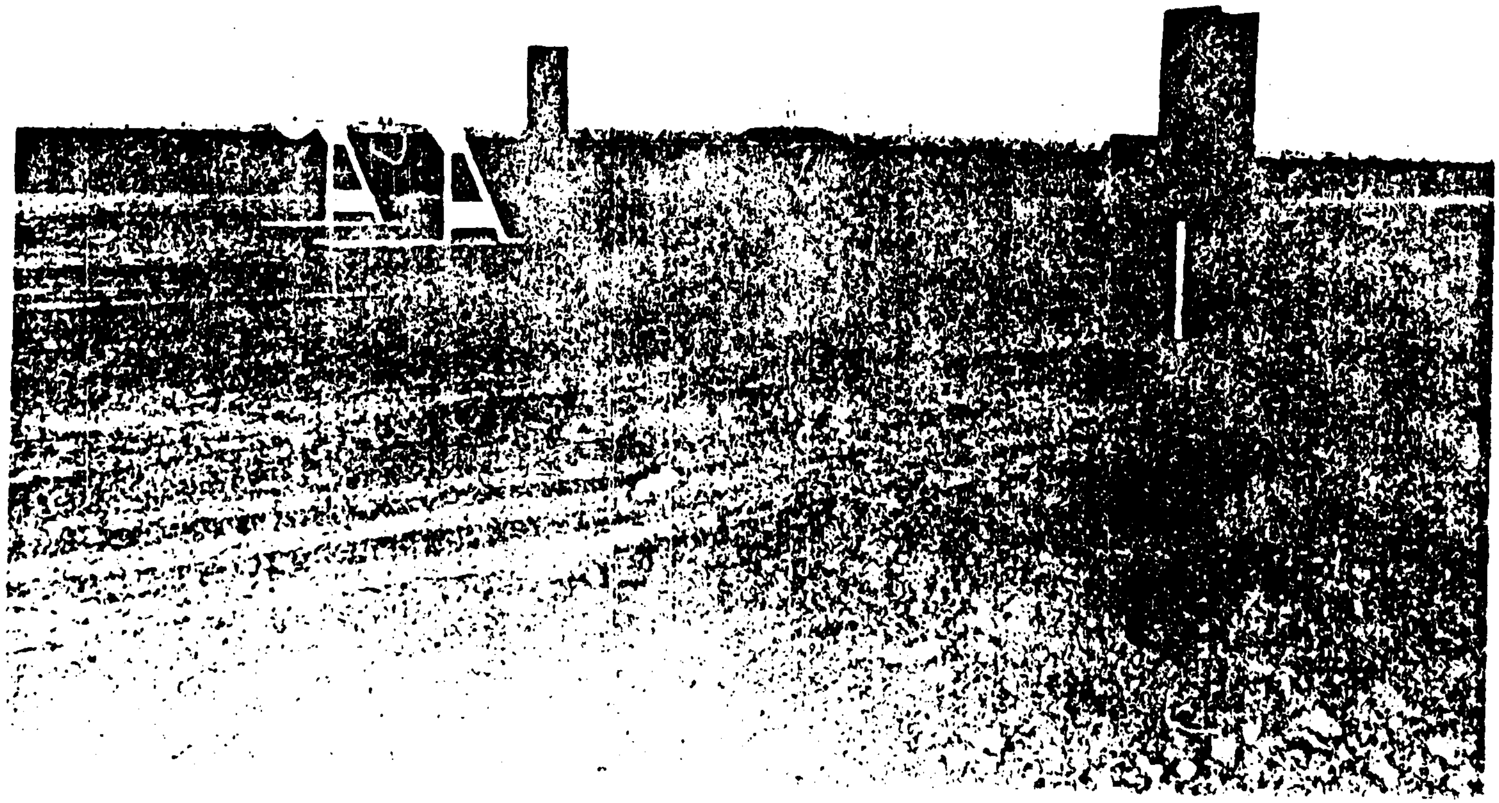

Figure 4-33. Generic shape I-beams (DNA 9103).

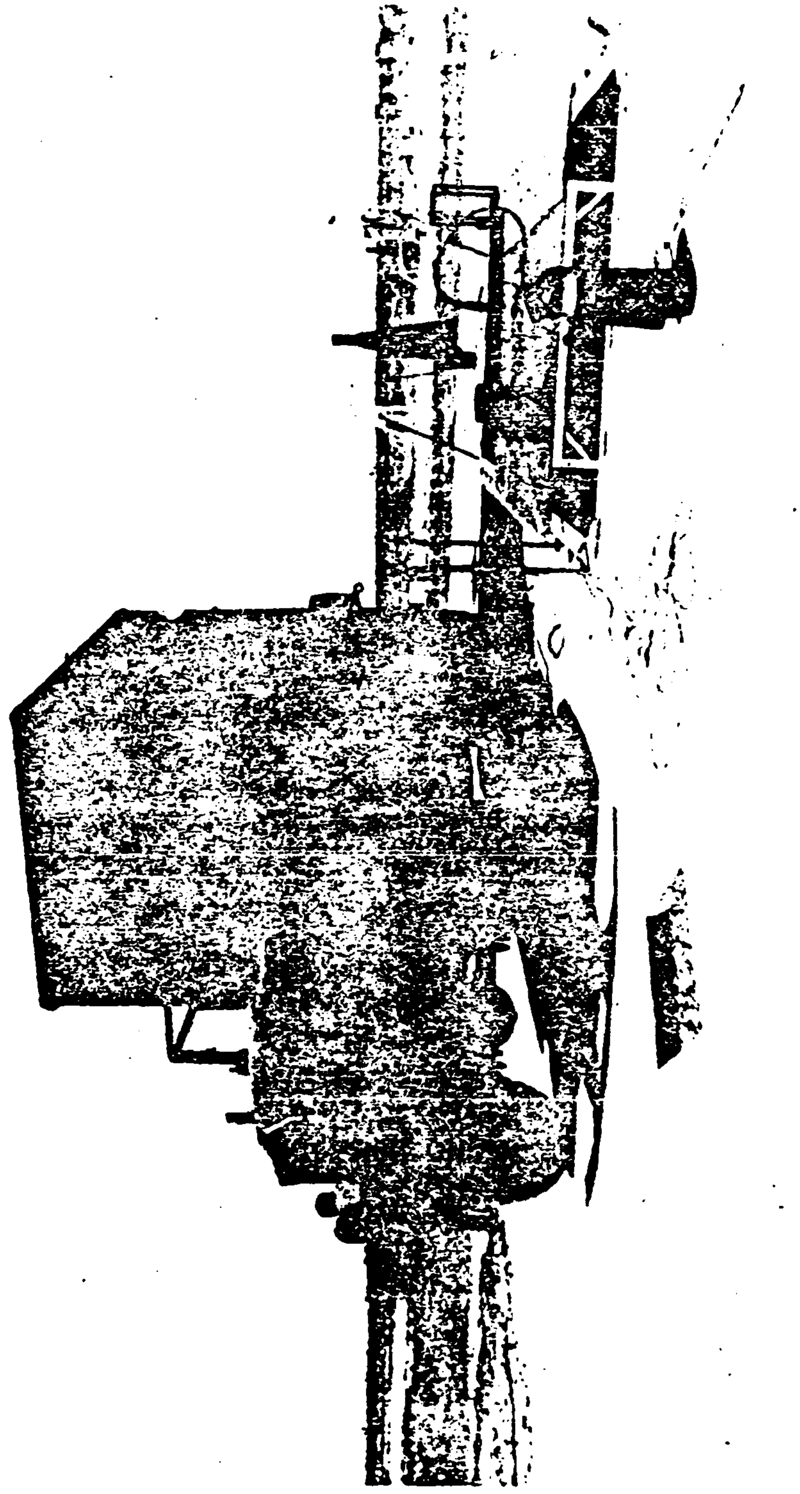

Figure 4-34. A-type shelter (BRL 2007).

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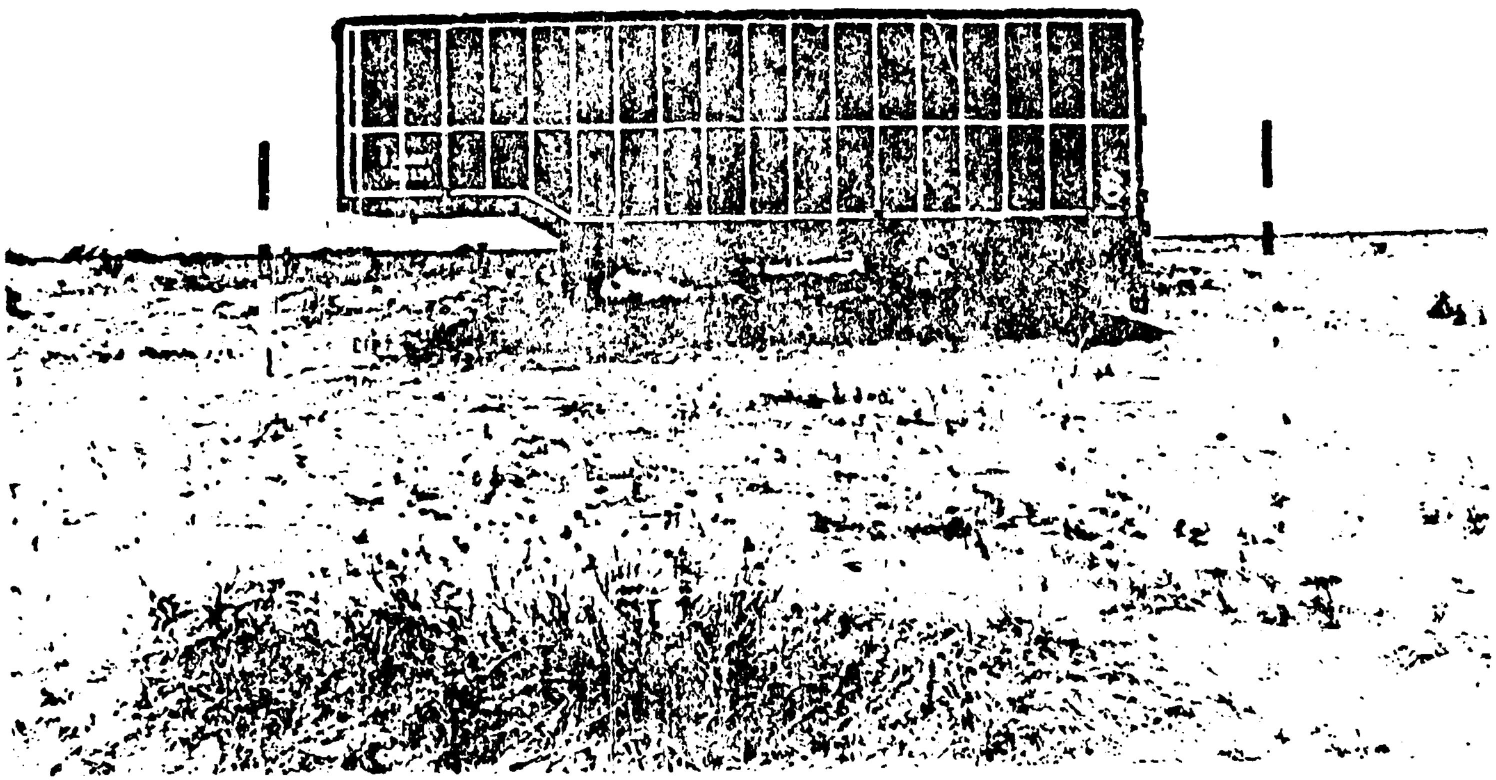

Figure 4-35. Army mobile electronic shelter (BRL 2053).

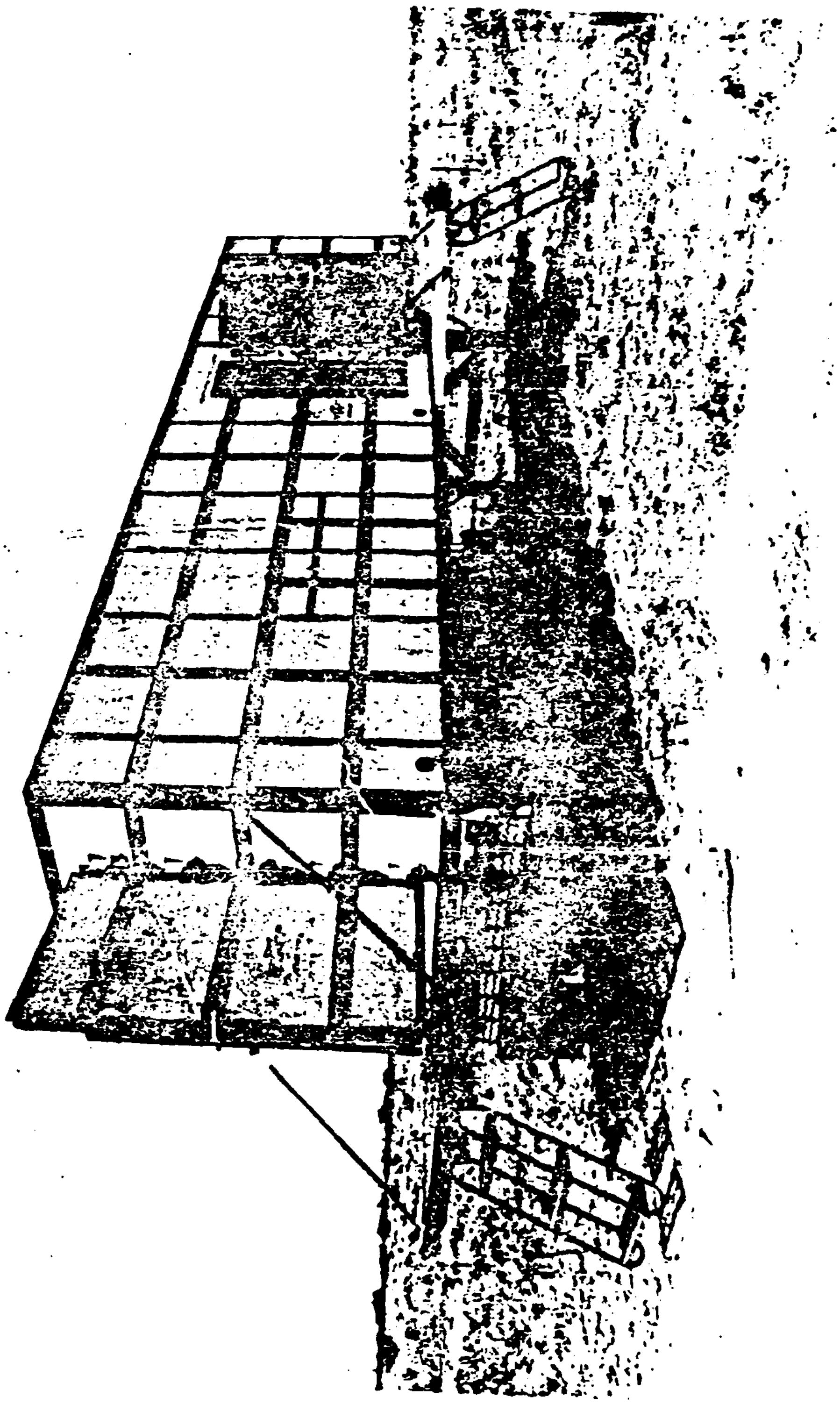

Figure 4-36. Army advanced trailer (BRL 2081).

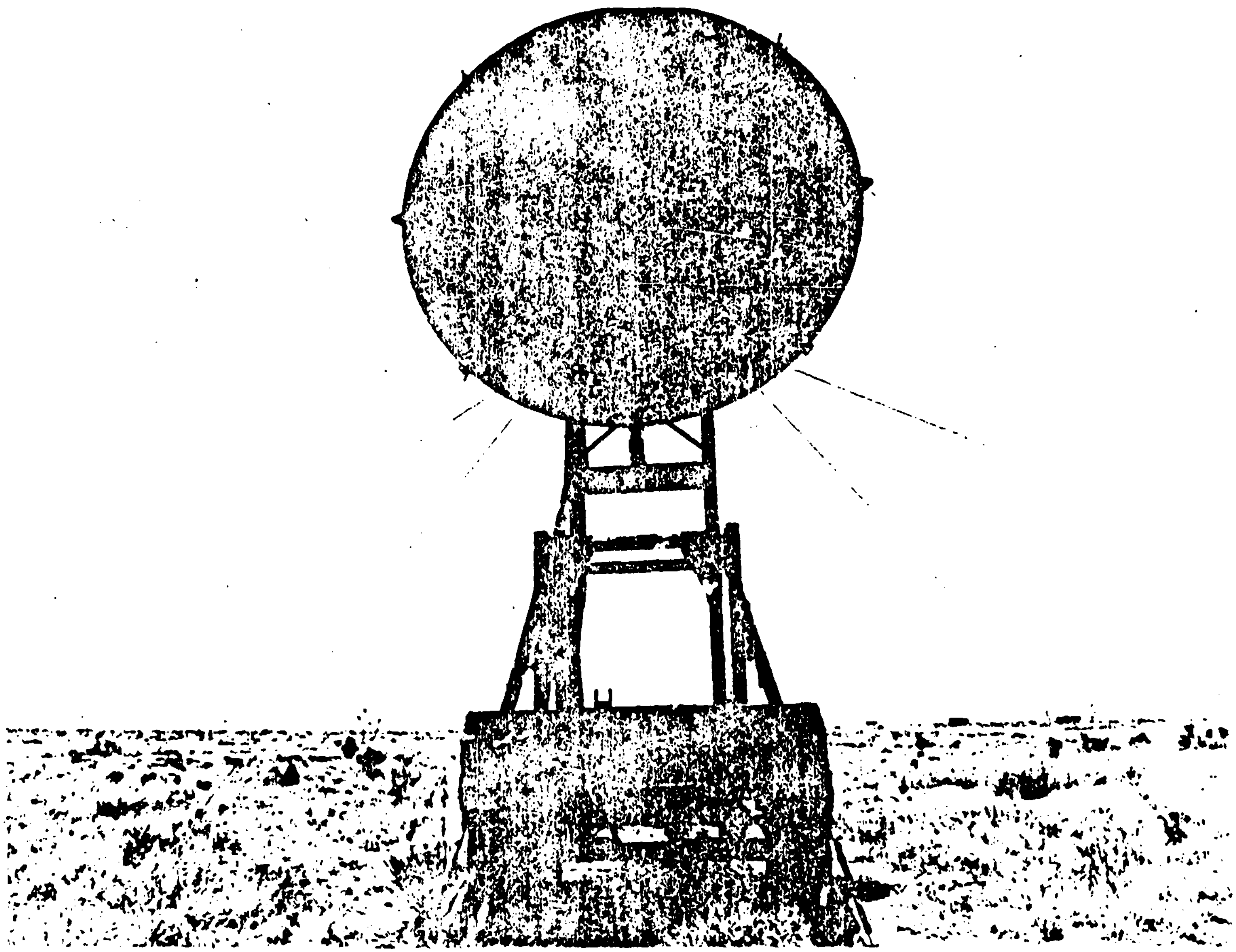

Figure 4-37. Trailer mounted dish antenna (preshot) (BRL 2192).

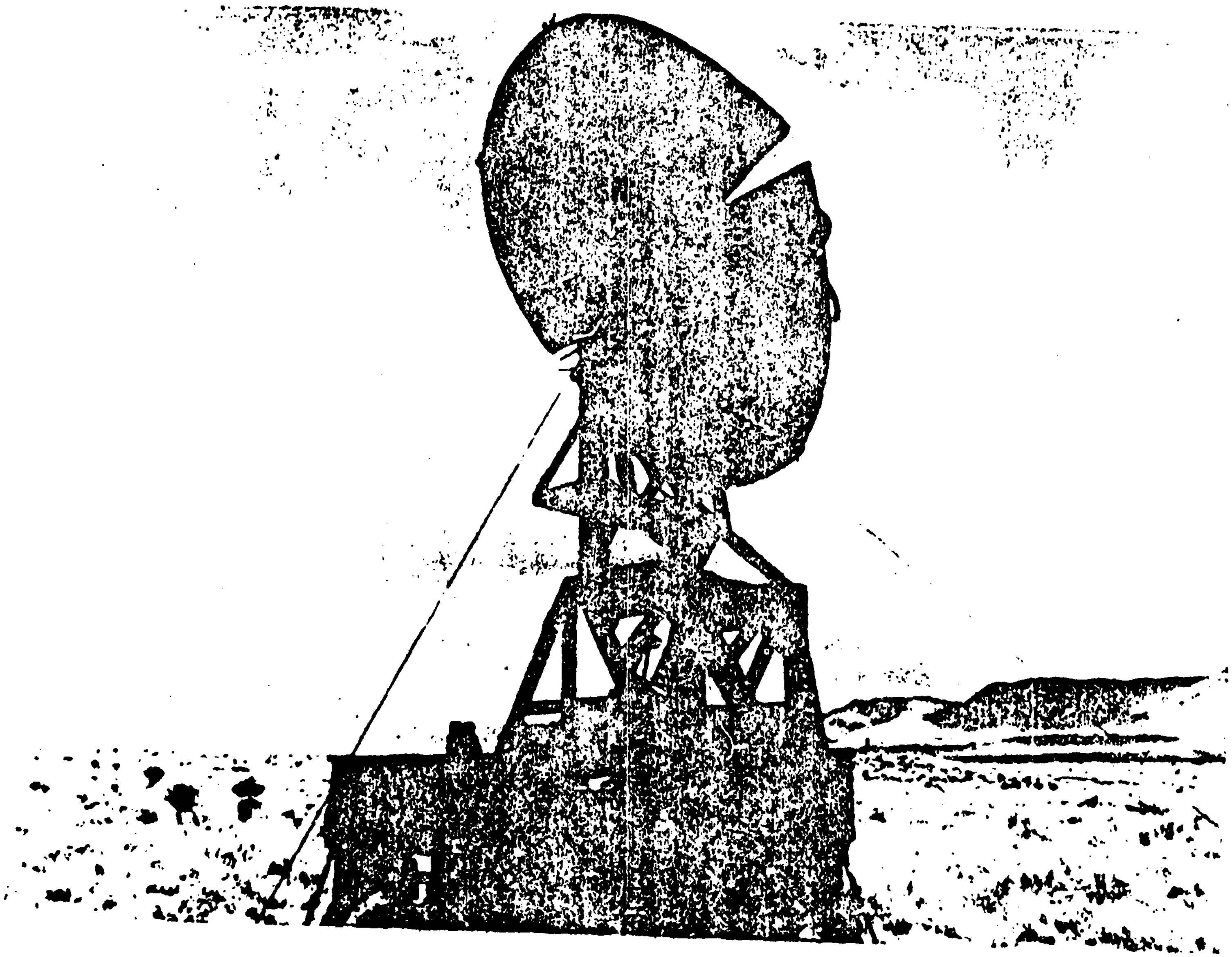

Figure 4-38. Trailer mounted dish antenna (postshot) (BRL 2192).

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4-3.10 Passive Fiber Optics (2251).

This experiment was sponsored by the US Army and fielded by BRL.

OBJECTIVE: Determine the effects of a combined thermal radiation and airblast overpressure on fiber optic samples.

DESCRIPTION: Six different cables were mounted on a metal frame and exposed to 65 cal/cm^2 and then to an airblast overpressure of 7.3 psi (50.3 kPa).

4-3.11 Biological Detection and Warning System (BDWS) and VDR-1 Radiacmeters (2306)

This experiment was sponsored by the US Army and fielded by WSMR.

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OBJECTIVE: Determine the effects of an airblast overpressure on operating units of the Biological Detection and Warning System (BDWS) and VDR-1 radiacmeters.

DESCRIPTION: Two operating units of the BDWS were located at the 7.3 psi (50.3 kPa) level. Each unit weighed 275 pounds (125 kg) and was 49 inches (1.24 meters) high, 40 inches (1.02 meters) wide, and 30 inches (0.76 meter) long. There was an operating VDR-1 radiacmeter in each of the two M-1 Abrams tanks (see 4-3.6 above).

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4-3.19 Helicopter Body (2791).

This experiment was sponsored by the US Army Nuclear and Chemical Agency (USANCA) and fielded by the Applied Technology Laboratory.

OBJECTIVE: Determine the airblast effects on the body of a helicopter.

DESCRIPTION: The body section of a UH1 helicopter was placed at a 45-degree angle (head-on) to the blast wave at the 2 psi (13.8 kPa) level. Figure 4-49 is a photo of the UH1 body after detonation.

4-4 DUST AND DEBRIS MEASUREMENTS.

4-4.1 Debris Enhancement (4501).

This experiment was sponsored by DNA and fielded by AFWL/CERF.

OBJECTIVE: Study debris enhancement against above and below ground structures as a function of distance from the crater.

DESCRIPTION: Hardened cameras were placed at five locations along 315° radial to observe debris impact, breakup and redistribution. Figure 3-44 shows the camera coverage.

4-4.2 Impacting Debris (4601).

This experiment was funded by DNA and fielded by AFWL/CERF.

OBJECTIVE: Define impacting debris environment including distribution, size, and terminal parameters.

DESCRIPTION: Selected free-field debris samples were sized and compared to in-situ, in-flight and secondary crater size debris. Four diagnostic cameras at Complex D, E, F, and G photographed in-flight debris. Figure 4-50 shows the location of the two areas where the free field debris samples were collected.

4-4.3 Airborne Infrared Radiometer (7651).

This experiment was sponsored by the US Air Force Tactical Applications Center and fielded by the Aerospace Corporation.

OBJECTIVE: Obtain infrared radiance in the 2 to 3 μm spectral range from the dust cloud produced by the explosion.

DESCRIPTION: The Aerospace Corporation flew a Learjet aircraft with airborne infrared radiometer equipment aboard observing the detonation cloud from H + 1 minute to H + 1 hour from a distance greater than 1/4 mile (402 meters).

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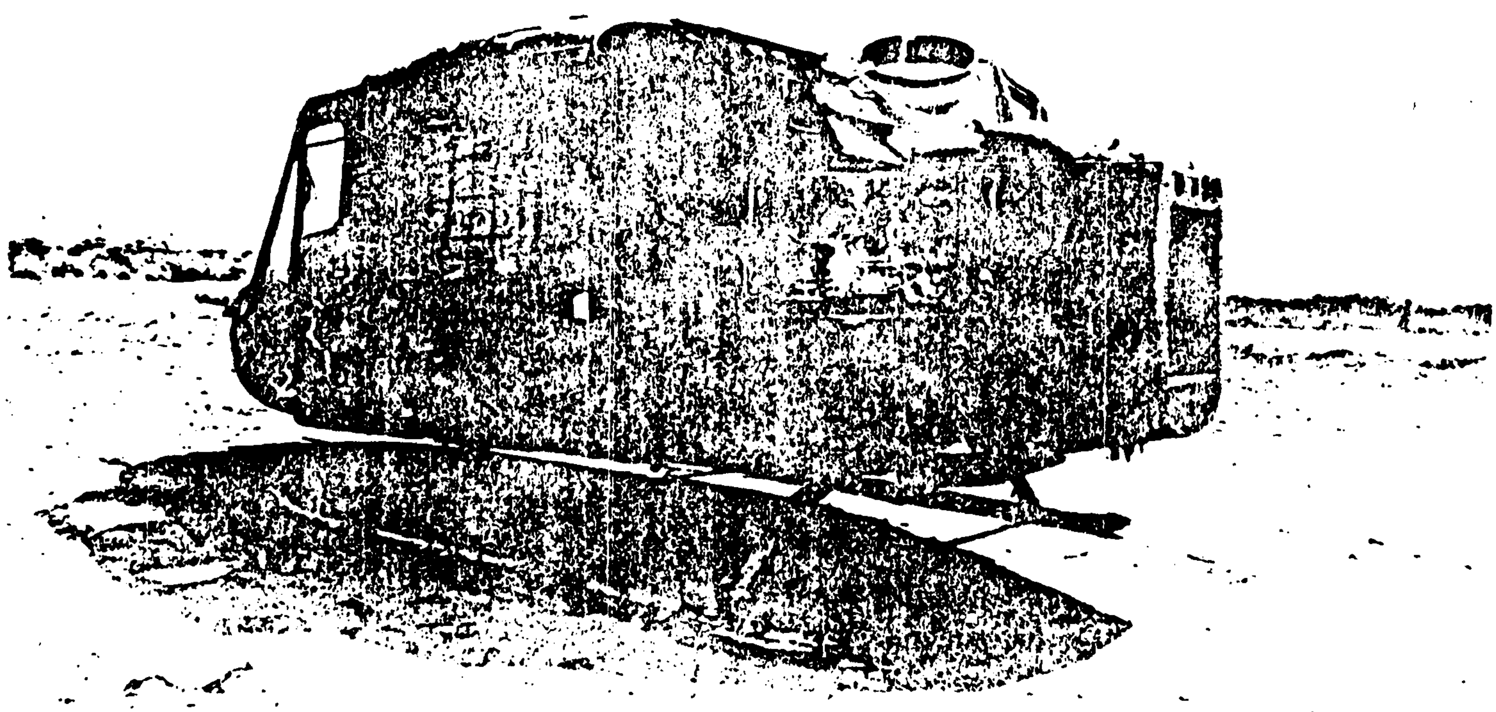

Figure 4-49. UH1 helicopter body (postshot) (USANCA 2791).

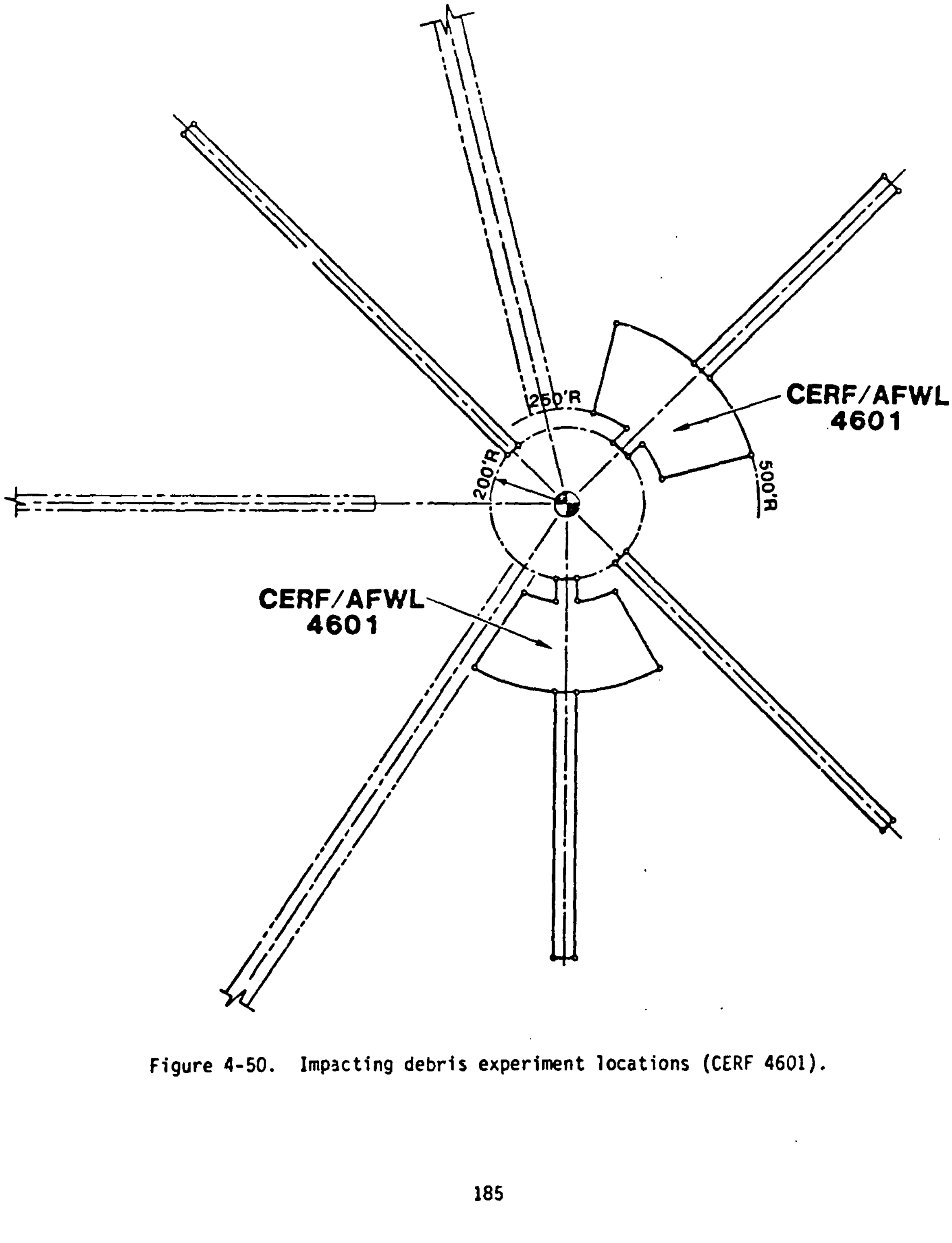

Figure 4-50. Impacting debris experiment locations (CERF 4601).

4-4.4 Dust Layer and Dust Density Studies (9101, 9102).

These experiments were sponsored by DNA and fielded by Teledyne Brown Engineering (TBE) and SAI.

OBJECTIVE: Measure dust effects on contrast of films (9101) and measure dust density and size distribution (9102).

DESCRIPTION: Six movie cameras (9101), three each at the 10 and 20 psi (68.9 and 137.9 kPa) levels, were aimed at targets which were 10, 17, 30, 50, 90, and 150 feet (3.1, 5.2, 9.1, 15.2, 27.4, and 45.7 meters) away. They were fielded by TBE and were used for the contrast studies. Figure 3-61 shows the camera coverage of Experiment 9101 and 9102 testbed and Figure 4-51 is a photo of the camera and target set up at the 10 psi (68.9 kPa) level. Eleven sensors (9102) at 24 and 70 feet (7.3 and 21.3 meters) from the cameras and samplers at 0, 24, 50, 70, 100, 125 and 150 feet (0, 7, 3, 15.2, 21.3, 30.5, 38.1, and 45.7 meters) from the cameras fielded by SAI/TBE were used for the density and size studies. Figure 3-62 shows far field camera coverage of Experiment 9102.

4-4.5 Dust Cloud Phenomenology (9191).

This experiment was sponsored by DNA and fielded by Technology International Corporation.

OBJECTIVE: Determine how the effect of lofted dust can be quantified in order to allow a predictable estimate of contrast (and hence resolution) degradation on a particular optical sensor system.

DESCRIPTION: Four matched camera systems of 1.97-inch (500-mm) focal length covering different spectral regions of the photographic spectrum were located at the MILL RACE Administrative Park. These cameras photographed a high contrast target structure located 1,100 feet (335.3 meters) south of GZ prior to and after charge detonation up to H + 2 hours.

4-4.6 Pebble Shape (9851).

This experiment was sponsored by DNA and fielded by SAI.

OBJECTIVE: Determine the breakup mechanism and the resultant size and shape distribution of ejected fragments for rocks and simulated rocks embedded in alluvium.

DESCRIPTION: Six bore holes were drilled at 22.97 feet (7 meters), 32.81 feet (10 meters), and 45.93 feet (14 meters) from GZ with the depth being 13.12 feet (4 meters), 9.84 feet (3 meters), and 9.84 feet (3 meters), respectively. Three holes were on radial E 5° S and three were on E 25° S. A total of forty-two formed concrete and Cedar City Tonalite samples were placed in the six holes. All samples were ejected upon charge detonation, photographed in place and then recovered for quantitative assessment. Figure 4-52 is a photo of the wire mesh catcher used to aid in recovery of the ejected samples.

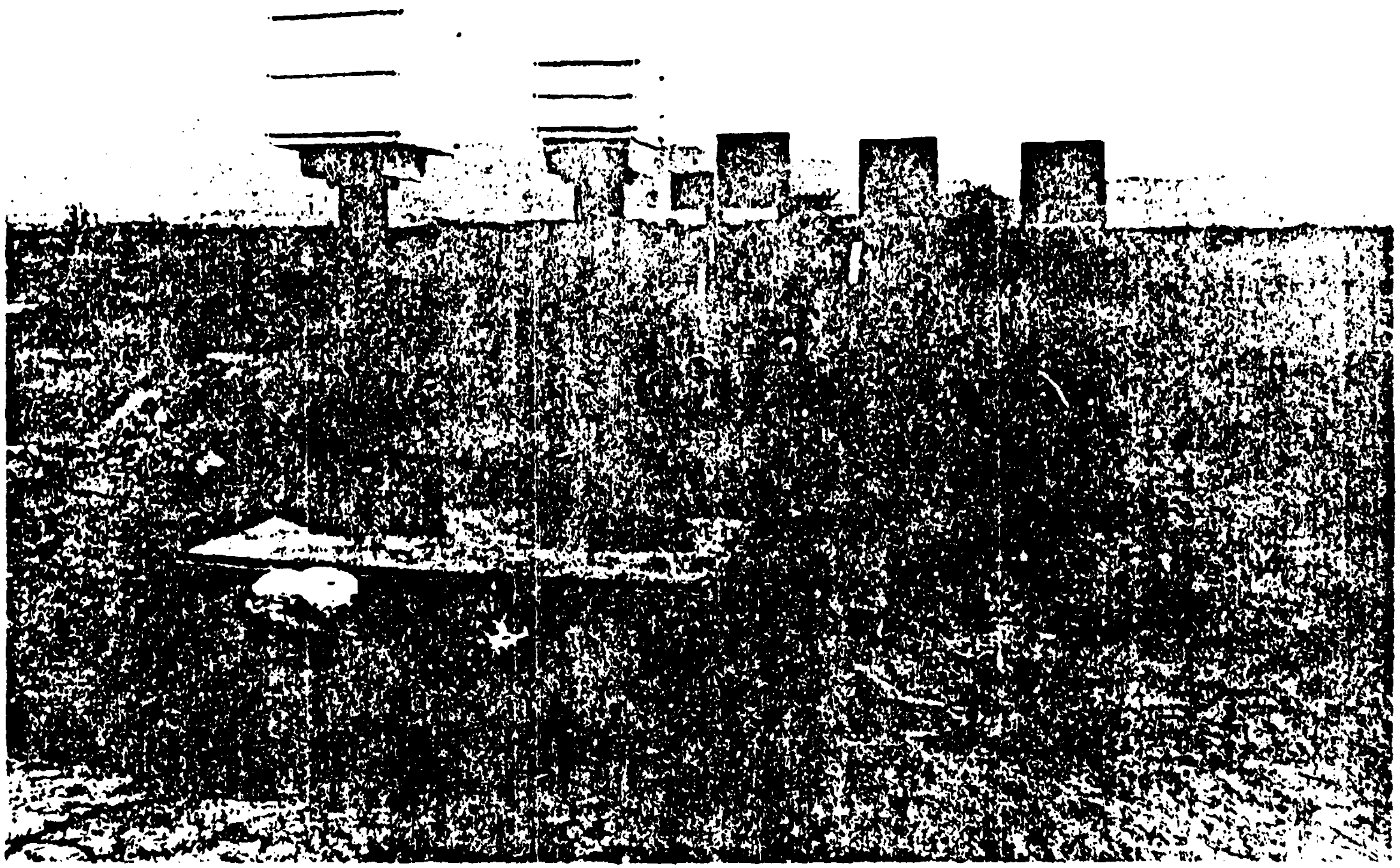

Figure 4-51. Dust effects study cameras and targets (DNA 9101).

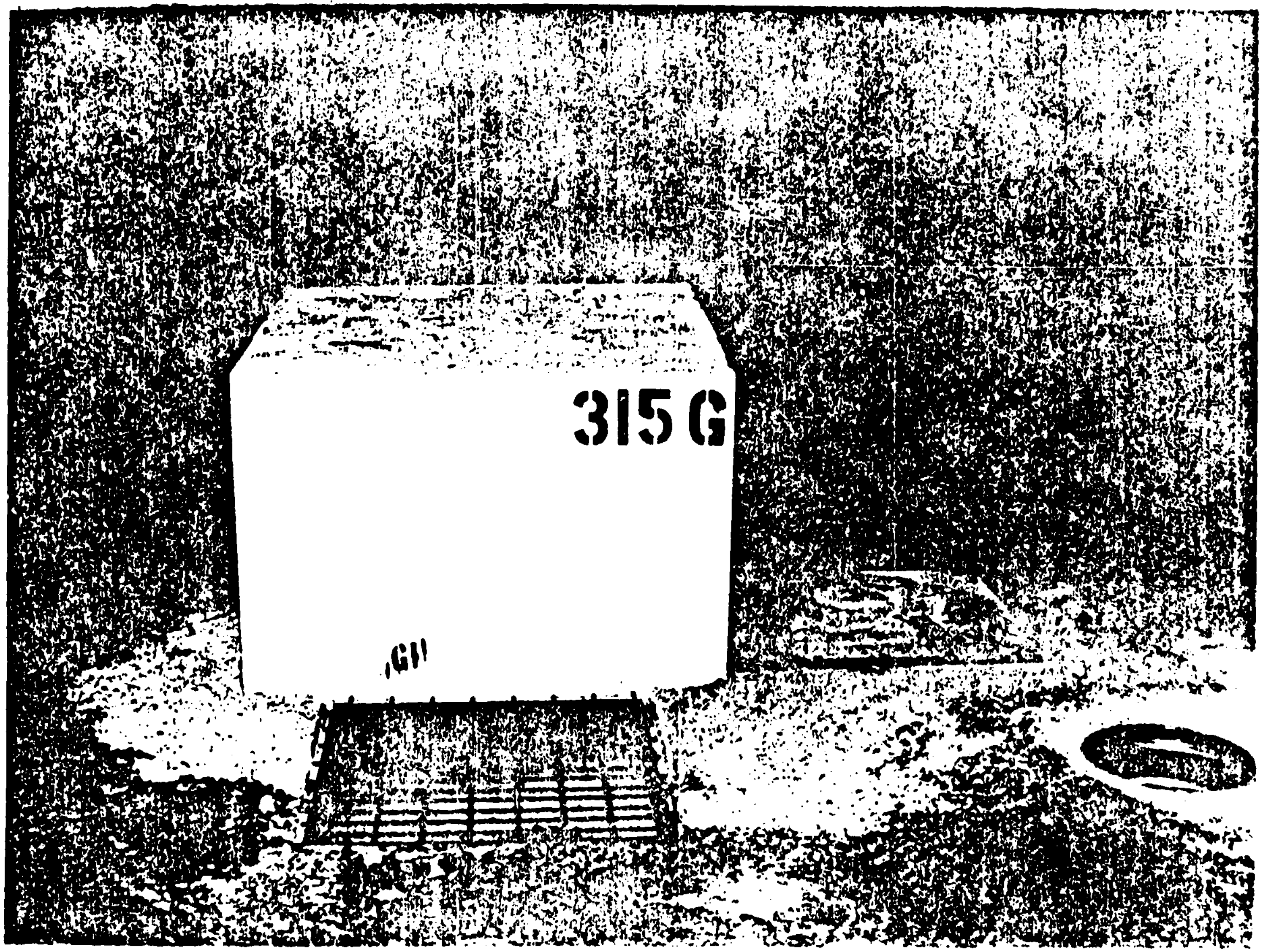

Figure 4-52. Wire mesh catcher (DNA/SAI 9851).

SECTION 5

FIELDING

5-1 CONSTRUCTION

The first phase of the MILL RACE fielding effort occurred in early February 1981 when work started on testbed preparation. Work then continued in accordance with the Planning Schedule shown in Figure 2-5. The testbed was essentially prepared by July 1981. Construction and fielding support, including manpower, equipment, and materials, was provided by the FE, WSMR. The support provided:

a. Complete testbed preparation

b. Experiment construction and installation

c. Roadbuilding into the testbed area

d. Administration and instrumentation parks preparation

e. Cable installation

f. Cement batch plant operation.

FEMA experiments required journeymen level tradesmen which FE could not provide. Therefore all FEMA experiments were constructed by a private contractor.

Because of the requirement to support preparation for three tests, i.e., MILL RACE, DISTANT RUNNER and MULTIBURST, and the Presidential hiring freeze, there was a shortage of laborers during the early phase of the testbed preparation. That shortage did not, however, result in any delay of the readiness period because the skilled personnel that FE did provide put extra efforts into their work to keep the site preparation efforts on schedule. Extra equipment, needed because of a shortage due either to the FE's requirement to support three tests simultaneously or lack of equipment in the FE's inventory, was rented on a reimbursable basis by FE.

Construction and preparation of the testbed proceeded smoothly with cable laying starting in February. The communication cables were completed in April; the gageline cable for signaling and T&F was completed in June as was the power cable. Cable laying from J-box to experiments and hookup of T&F cable was continued through July and was completed in early August.

The administration and the two instrumentation parks were ready for trailers in April. Administrative trailers were moved into the park later in April and made ready for full-time occupancy on 1 June. Instrumentation trailers started to move into the instrumentation parks in May and continued to do so until early August. Telephones and radio nets were hooked-up and ready for use in June. The TGS started their fielding phase in increments starting in March with the complete staff in the field on 1 June. The arrival of experimenters started in May and continued into August.

5-2 LOGISTIC SUPPORT

Logistic support for the fielding phase of MILL RACE was provided by a combination of agencies. The administration trailers were leased by FCDNA from Elder Equipment Leasing Inc., Albuquerque, NM. Elder moved the trailers to the Administration Park, set them up, and subsequently removed them after the test. Primary power distribution to the administration and the two instrumentation parks was provided through a contract with Socorro Power and Light Cooperative. Secondary distribution system and hookups were supplied by WSMR FE.

Transportation was provided by both FCDNA from their assets at NTS and leased government vehicles through WSMR. Vehicle maintenance, fuel, and parts were provided by both WSMR and the 1606 Air Base Wing, Military Airlift Command, Kirtland AFB, NM.

Most of the TGS were lodged in the El Rio Motel, Socorro, NM, under a government contract.

Basic administrative supplies and expendables were provided by FCDNA. To purchase building supplies, hardware items, and radio and automotive parts that were not readily available from WSMR, Blanket Purchase Agreements were made with the following Socorro, NM firms:

Tree Mart Building Supply
Crabtree Building Supply
Radio Shack
Center Hardware
Scott's Auto Supply
Marlin Auto Supply.

WSMR provided communication support services (telephone, hookups, base radios); security services (road guards and roving patrols) through their existing civilian contractor; fire protection support from the Stallion Range Center Station; and meterological support.

5-3 SAFETY OF EXPLOSIVE HANDLING

WSMR Regulation 385-15 (Appendix C-1) prescribes the policy, procedures, and responsibilities relating to the development and approval of SOPs for hazardous operations at WSMR. Regulation 385-15 was complemented by Test Directorate's "FCTOH Safety Plan For the HE Test" (Appendix C-2). Each TGS is required to supplement the Test Directorate document with information about hazards and safety requirements peculiar or unique to that test. The "MILL RACE Safety Plan," April 1981 (Appendix C-3) and the SOPs for explosive operations for MILL RACE (Appendices C-4, C-5, and C-6) provided the information about hazards and safety requirements and described the method of performing the MILL RACE hazardous explosive operations. Sections 3-1 and 3-2 describe construction of the stack and booster systems, respectively.

5-4 EVENT EXECUTION

MILL RACE was detonated at 1236 MDT on 16 September 1981 after a hold of 2 hours and 36 minutes because of drone (9301) brake and drone ground control computer problems. Following the countdown procedures shown in Appendix I, the countdown had proceeded to T-12 minutes for a scheduled detonation at 1000 MDT when the drone brake problem on the second drone occurred, followed by the computer problems. The first drone already airborne, had to be recycled for fueling while the brake and computer problems were corrected necessitating a minimum two hour delay. After the problems were resolved, the drone countdown was resumed and picked up the MILL RACE countdown at T-12 minutes (1221.5 MDT) and proceeded to a planned hold at T-3 minutes (1230.5 MDT) for drone synchronization. Countdown resumed at T-3 (1233 MDT) and proceeded through zero time. Appendix J contains the countdown hold policy that was developed for MILL RACE and which was used during the hold for the drone problems.

5-5 OBSERVATION POINT

In that MILL RACE was an unclassified test, there were no restrictions on observers. Informal invitations were sent out through experimenters and program participants. In all, over 400 people observed the test.

Because of safety considerations for the drones, the observation point had to be located 15,000 feet (4.57 km) outside of the drone's flight path. A location east of Miller's Watch on the rise to the Oscuro Mountains was selected. Access was by an unimproved one-way road which mandated the use of buses to transport observers. Eleven buses brought observers from Albuquerque, Main Post WSMR, and Stallion Range Center WSMR. In addition, three helicopters were used by VIPs. Food, water, medics, latrines, viewing stands, and video were available to observers. Figure 5-1 is a location map and layout of the observation point.

5-6 SITE RESTORATION

Experiment damage evaluation, analysis, and recovery commenced immediately after the event. Most recovery was accomplished within one week and all experimenters but those studying the crater and debris had left the testbed within two weeks. Crater studies were completed in early November 1981.

Essentially no site restoration was accomplished during the first month due exclusively to an FE labor shortage and other higher priority work. Cable recovery commenced 19 October and was completed in early December 1981. All accessable cable was removed from the testbed, a portion of which was sent to salvage and the remainder recovered for future use.

The crater was backfilled and compacted for possible future airblast only use. Work was completed by early January 1982. Major concrete foundations were left in place and staked. Some of these foundations can still be recovered if future use dictates. The

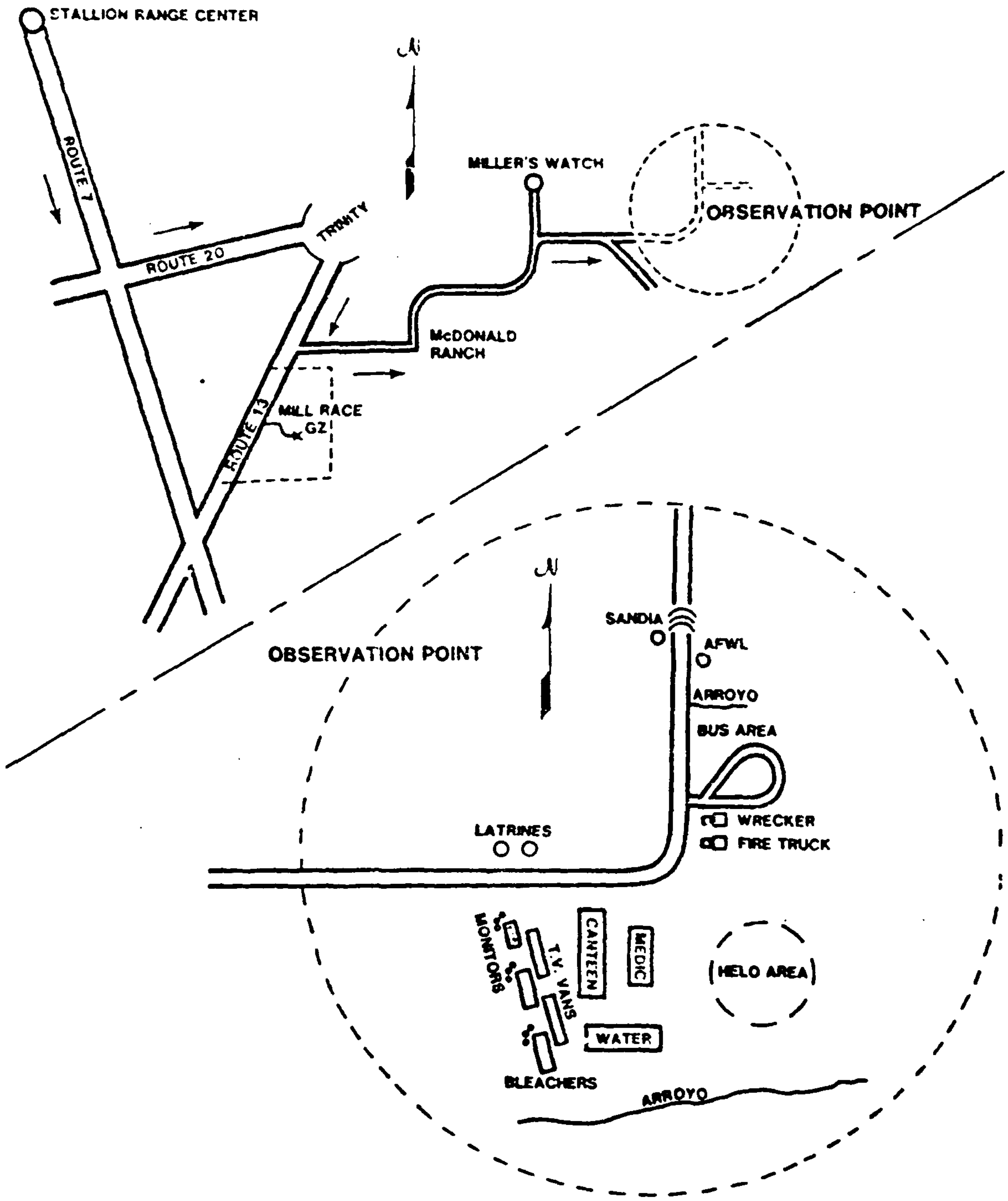

Figure 5-1. MILL RACE observation point location and layout.

TRS pits were covered and surrounding areas made safe and left for future use. All small obstructions, anchors, debris, and nuisance items were removed to a sanitary landfill behind the cable yard. Below grade experiment structures were crushed, filled, and buried for safety reasons. All camera pedestals except the ones around the TRS pits were removed by WSMR and stored for future use. Airblast gage mounts were also removed and stored for future use. All clean-up work was completed by early January 1982.

Roads, administrative and instrumentation parks, cable yard, electrical power and telephone systems, and diagnostic camera bunkers were left intact for future use as a Permanent High Explosive Test Site (PHETS). Proposed site upgrade actions include a semi-permanent office building and an expanded storage area partially fenced. Reusable equipment and material were retained onsite.

5-7. LESSONS LEARNED

Appendix K is a compilation of the lessons learned by the TGS in fielding MILL RACE.

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APPENDIX A

ACRONYMS AND ABBREVIATIONS

APPENDIX A

Acronyms and Abbreviations

AFB	Air Force Base
AFWL	Air Force Weapons Laboratory
ANFO	ammonium nitrate fuel oil
BDWS	Biological Detection and Warning System
BFEC	Bendix Field Engineering Corporation
BIS	booster initiation system
BRL	Ballistics Research Laboratory
CBB	Communication Box Body
CERF	Civil Engineering Research Facility
DARPA	Defense Advanced Research Projects Agency
DDST	Deputy Director Science & Technology
DNA	Defense Nuclear Agency
DOD	Department of Defense
DOE	Department of Energy
DTNSRDC	David Taylor Naval Ship Research & Development Center
EA	Environmental Assessment
EMP	electromagnetic pulse
FC	Field Command DNA
FE	Facility Engineer
FEMA	Federal Emergency Management Agency
FIDU	fiducial (signal)
FM	frequency modulated
GZ	ground zero
HATS	hardened tactical shelter
HE	high explosive
ISO	International Standards Organization
KOA	Ken O'Brien Associates
LANL	Los Alamos National Laboratory
LATA	Los Alamos Technical Associates
MBA	main booster assembly
MFP	mandatory full power
MX	missile X
NAVSEA	Naval Sea System Command
NBC	nuclear, biological, and chemical
NOAA	National Oceanic and Atmospheric Administration
NRP	National Range Programs
NSWC	Naval Surface Weapons Center
NTS	Nevada Test Site
OCE	Office of Civil Engineering (US Army)
OP	Observation Point
PAI	Physics Application, Inc.
PI	Physics International
POM	project officer meeting
POR	Project Officer Report
pps	pulses per second
PVC	polyvinylchloride
SAI	Science Applications, Inc.
SEA	Scientific and Engineering Associates
SNLA	Sandia National Laboratories, Albuquerque
SOP	Standard Operating Procedure
SRII	Stanford Research Institute, International
SSI	Scientific Service, Inc.
SSS	Systems, Science & Software
TBE	Teledyne Brown Engineering
TD	Technical Director
TGD	Test Group Director
TGE	Test Group Engineer
TGS	Test Group Staff
T&F	timing & firing
TIC	Technology International Corporation
TRI	Tech. Reps., Inc.

TRS	thermal radiation source
UDS	Universal Documentation System
UK	United Kingdom
UNM	University of New Mexico
USANCA	US Army Nuclear and Chemical Agency
WAC	Williams Aircraft Company
WES	Waterways Experiment Station
WSMR	White Sands Missile Range

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APPENDIX B

OPERATIONS REQUIREMENTS & DIRECTIVES

B-1. OPERATIONS REQUIREMENT No. 96301
B-2. OPERATIONS DIRECTIVE No. 96301A
B-3. OPERATIONS DIRECTIVE No. 96304A
B-4. OPERATIONS DIRECTIVE No. 96308A
B-5. OPERATIONS DIRECTIVE No. 97916A

APPENDIX B-1

OPERATIONS REQUIREMENT No. 9 6 3 0 1

MILL RACE

(PROGRAM SHORT TITLE)

OR NO. 9 6 3 0 1

TEST DESIGNATOR(S)	TEST TITLE
A	600 Ton ANFO Event

20 May 1981
DOCUMENT DATE

WHITE SANDS MISSILE RANGE
NEW MEXICO

RMN

OR NO. 96301	APPROVAL AUTHORITY	DATE: 20 May 1981
UDS PARAGRAPH 1010		TEST DESIGNATOR(S): A

PROGRAM TITLE: MILL RACE

1. All paragraph and subparagraph classification markings have been reviewed and have been determined to be properly marked in accordance with paragraph 4-202, DOD 5200.1-R.
2. None of the support requirements stated herein exceed the scope of previously accepted planning documents pertaining to this program.

FOR THE RANGE SPONSOR:

Tomio Katsura — CHIEF, RANGE PROGRAMS DIV.

Signature — Title

My review of this document has established the following:

		Yes	No
(1)	Scope of test is within PI/SC.	X	
(2)	Information is adequate for test support.	X	
(3)	It complies with policies and format (Range Users Handbook).	X	
(4)	All support developments (if any) of the Range essential to this test are ready.		X
(5)	User funds are available to pay dir... ...sts of support planning.	X	

Based on the above, this document is:

- [ ] Accepted FOR THE RANGE
- [x] Referred to Range Management

For G.L. MEADOWS

NR Project Engineer

DATE: 10 JUNE 1981

RECEIVED NR-P 10 JUN 1981

RANGE MANAGEMENT COMMENTS (if applicable): 10 Jun 81

This OR is accepted, as the support developments are forecast for completion before the first-test date.

G. L. Fleharty

G. L. FLEHARTY

Chief, Air & Sea Systems Branch

SECURITY INFORMATION: (General Declassification Schedule stamp)

STEWS NR-P Form 8
19 Jul 78 (Rev)

NATIONAL RANGE USERS HANDBOOK

PREVIOUS EDITIONS WILL NOT BE USED

OR NO: 96301	DISTRIBUTION	REVISION NO:
PARAGRAPH 1020		~~OR TEST~~ DESIGNATOR(S): A

*AA. 1

AFC 1

ATZC-MDMC-SE 1

*CCNC-TWS. 3

*DELAS-DP 1

*FE-ER 1

*LG-R 3

NR-AO 4

NR-CF 2

*NR-CR 6

*NR-D 7

NR-CS 2

*NR-CS-DMA 1

NR-CE 1

NR-PD 6

NR-PR 1

NR-CU 0

PL 0

QA 0

DP-F. 1

*DP-S. 1

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AIR FORCE

AD-RUC. 1

Cdr, 6585 Test Gp, ATTN: AD-RUM,
Holloman AFB, NM 88330. 1

Cdr, 6585 Test Gp, ATTN: ATO,
Holloman AFB, NM 88330. 0

Cdr, Armt Div
ATTN: AD-TEPA, Eglin AFB,
FL 32542 0

Field Command, DNA
ATTN: FCTOH
Kirtland, AFB NM 87115 10

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TE-MF 2

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NOMTF 0

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*Replies required.

PROGRAM TITLE: MILL RACE
OR NO.: 96301
DATE: 20 May 81

1. PROGRAM INFORMATION ADMINISTRATIVE AND TECHNICAL

1000. Administrative Information Key Personnel

a. MILL RACE Test Group Director

LCDR G. H. REID — Test Site: (505) 679-4183 Commercial
349-4183 Autovon
FCDNA: A/V 244-4651
Socorro: (505) 835-0510

b. MILL RACE Deputy Test Group Director

LCDR W. F. TAYLOR — Test Site: (505) 679-4183 Commercial
FCDNA: A/V 244-4651
Socorro: (505) 835-0510

c. MILL RACE Test Group Engineer

LT Roy E. Garcia — Test Site: (505) 679-4183 Commercial
FCDNA: A/V 244-8261
Socorro: (505) 835-0510

d. MILL RACE Test Coordiantor

Mr. Lee Meadows, STEWS-NR-PD (505) 678-1622

1100. Program and Mission Information

a. Test Program Objectives

MILL RACE consists of one 600 ton high explosive event designed to provide a blast and shock environment for Department of Defense sponsored experiments utilizing scaled and unscaled shelters, and tactical and strategic systems and vehicles.

Augmenting the blast environment will be a separate simultaneous thermal radiation source (TRS) providing a thermal environment for selected experiments.

b. Test Program Restraints

(1) Meterological conditions of (a) wind shear and/or temperature inversions that could cause enhancement of the shockwave; (b) blowing dust which would reduce visibility or affect camera coverage; or (c) excessive cloud cover (above 50%) which would adversely affect aircraft participation could result in a hold condition.

(2) It is intended that the test be scheduled for execution at 1000 hours with a slide window until 1400 hours.

(3) The test could be placed in a hold condition due to unspecified malfunction of instrumentation, particularly airblast and photographic instrumentation systems.

c. Abbreviations

SNL - Sandia National Laboratory

NSWC- Naval Surface Weapons Center

BRL - Ballistic Research Laboratory

WES - Waterways Experiment Station

TRS - Thermal Radiation Source

SAC - Strategic Air Command

AFTAC - AF Technical Applications Center

d. Airborne Participation

(1) The F-86 Drone Flyby experiment will be in separate OR's.

PROGRAM TITLE: MILL RACE
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(2) Aircraft control support is required for the following experiments:

(a) SAC. Damage Assessment and Strike Tactic experiment (No. 7501) may use numerous strategic aircraft to evaluate electro-optic viewing system (EVS) damage assessment/strike tactic. Overflights before and after test will occur at altitudes from 400' AGL to extremely high. These overflights will be documented in OR 96308:

(b) AFTAC. Aerospace infrared cloud measurement (No. 7651) will be made by an infrared radiometer attached to a Learjet. Flight vector control will be required from before the detonation to one hour after detonation.

(c) Sandia National Laboratory requires flight control of an A-7 aircraft which will be dropping four flare canisters to record blast and acceleration in the upper atmosphere. Radar track, a radar plot, and telemetry support for data transmission from the canisters is required. Frequency to be in 225-399.9 MHz range for vectoring only. (See OR 97916)

(d) Williamson Aircraft Company will provide aerial photography of the event. Th photography will require overflights of the ground zero area and within a five mile radius to altitudes of 18,000 feet AGL from D-2 through D+3 days.

1500. <u>Requesting Agency's Instrumentation</u>

a. Airblast instrumentation will be installed and designed by Army Ballistic Research Labs (BRL).

b. Ground Motion instrumentation will be designed and installed by US Army Engineer Waterways Experiment Station (WES).

c. Instrument data recordings will be done by Bendix Field Engineering Corporation.

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1600. System Readiness Procedures/Tests

MILL RACE D-45 Day Countdown

±TIME	EVENT	ACTIVITY
D-45	SAC High Altitude Flight. U-2 photo recon support.	SAC
D-45	Start signal dry runs on request by experimenter.	IE
D-40	SAC Survey Flight (Army Aircraft, Hollomar AFB).	SAC
D-35	Conducts TRS Warm Test.	TRS
D-30	WSMR make daily weather reports to TGD.	WSMR(MET)
D-30	Commence scheduled daily signal dry runs.	IE/TRS
D-30	MILL RACE test put on WSMR 30 day forecast.	WSMR
D-21	Conducts computer simulated drone test.	ARMTE
D-20	Report to TGD status of experiments for upcoming FPFF (Full Participation, Full Frequency	TD
D-18	Technical and Diagnostic Cameras Installation begins.	WSMR (OPTICS)
D-17	ANFO manufacturing begins.	PD
D-17	Conducts FPFF dry run, submit report to TGD.	TD
D-17	Meteorology launches balloon.	WSMR(MET)
D-17	Check status of security guards for GZ and Oscura Gate.	PD
D-15	Deliver MBA. Commence delivery of ANFO. ANFO security force begins.	PD
D-14	Report readiness status of experiments.	TD

PROGRAM TITLE: MILL RACE
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D-12	Conduct computer simulated drone test.	ARMTE
D-8	Complete camera installation	WSMR/ (OPTICS)
D-8	Report readiness status of all experiments for MFP (Mandatory Full Participation) dry run.	TD
D-7	Conduct MFP dry run. Report performance to TGD. Film run all cameras.	TD/ OPTICS
D-7	MILL RACE test put on WSMR 7 day schedule.	WSMR
D-7	Meteorology Balloon launch.	WSMR(MET)
D-7	Drone dress rehearsal (2 drones, manned flight). All transmitters and tracking radars on.	WSMR/ARMTE/ FSI
D-7	Submit status report to TGD on readiness of all experiments.	TD
D-7	Submit status report to TGD on ANFO stacking.	PD
D-6	Review film from dry run on D-7.	WSMR(TGD)
D-5	Adjust cameras as necessary and report readiness of cameras to TGD.	WSMR (OPTICS)
D-3	Complete ANFO stack. Secure. Report readiness to TGD.	PD
D-3	MILL RACE test coded in WSMR scheduling system.	WSMR
D-3	Staff report final status to TGD.	TGS
D-2	Dress rehearsal (MFP) (see 360 minute countdown, Para. 2000).	TD
D-2	Drone participation in dress rehearsal.	ARMTE

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D-2	All aircraft participate except A-7.	WSMR/ARMTE/ AEROSPACE WILLIAMSON
D-2	Dress rehearsal report to TGD.	TGS
D-1	Remove ANFO stack girdle and covers, weather permitting	PD
D-1	Conduct test briefing for WSMR.	TGD
D-1	Load cameras.	WSMR
D-1	Pre-arm B/S	SNL
D-1	Far Field recording set-up.	SNL
D-1	Aerial photos	WAC
D-1	Check status of road guards.	PD
D-0	Event (See 360 minute Countdown, Para 2000)	
D+1 1/2	[redacted]	[redacted]

1700. Test Envelope Information

[redacted]

DOH (b)(3)

b. Aerial photography will be conducted by Williamson Aircraft Company. The photo plane will launch and recover at Socorro Airport. Flight plans call for range entry near Stallion Range Center at 18,000 ft MSL and circling GZM for 30 min during T-0. WAC will exit the range via the Stallion Range Center route to Socorro Airport to reconfigure cameras. Additional periods of photo taking for 1-2 hours will take place on D-0 thru D+3. (See airspace map page 25).

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c. Aerospace infrared cloud measurements will be made by an infrared radiometer attached to a Learjet. The Learjet will launch and recover at Alamogordo Airport. Flight plans call for the Learjet to travel North off range to US Route 380 then West along 380 and then circle over the WSMR extension at 3000 ft AGL. At T+4 min. the Learjet will arrive at GZM. It will circle and follow the dust cloud in a right-hand turning 3 mile radius circle. (See airspace map page 26).

d. F-86 Drones will fly over the testbed at T-0. A separate OR will address drone involvement on MILL RACE. (See airspace map page 27).

e. Sandia National Laboratories will conduct an experiment that involves parachute retarded instrument canisters dropped from 38,000 ft MSL, near GZM at T-zero. A separate OR will be written to cover this involvement on MILL RACE. (See airspace map page 28).

1800. Operational Hazards

a. Explosive

(1) 600 tons of ANFO stacked in a cylindrical hemispherically capped shape approximately 30 feet diameter by 34 feet high. The ANFO will be mixed off site, shipped and stacked in 50 lb bags.

(2) Main booster assembly 203 lbs new (Octol).

(3) Booster Initiation System 245 lbs new (Pentolite).

b. Aircraft

(1) B52 flyover

(2) Parachute instrument drop

(3) Dust cloud analysis.

(4) Aerial photo plane

c. Fuels - TRS nozzle pits contain compressed propane gas and liquid oxygen supplies. There is possible disturbance of these container due to blast. Small quantiites of MO gas and diesel fuel contained in US Army Tacticle Vehicles and electrical generators will be present. See Operational Hazards (STEWS-NR-P Form 1).

OPERATIONAL HAZARDS				1. DATE: 20 May 1981
2. PROGRAM TITLE: MILL RACE	3. VEHICLE NAME: TRS		4. OR NUMBER: 96301	5. TEST DSG: MILL RACE
6. SERIAL NUMBER: DNA-MR-1	7. LAUNCH LOCATION WEST RADIAL		8. IMPACT LOCATION: NA	

9. ITEM	10. ITEM DESCRIPTION	11. LOCATION
1	Liquid Oxygen (LOX)	Tank Filling
2	Liquid Oxygen (LOX)	TRS Pit
3	Liquid Propane	TRS Pit
4	Compressed Nitrogen Gas	TRS Pit

12. Prior to TRS burns LOX must be transferred from supply sources to TRS pit tanks. Pre test harazards are characteristic of the items contained under high pressure. Post test hazards maybe greater, due to pressure tank damage, caused by main event shock damage.

13. RADIOACTIVE HAZARDS

a. Is radioactive material used in this test? (Answer Yes or No) No.
b. If 13a is Yes, is the use of the materials governed by NASC procedures? _____
c. If 13b is Yes, the quantity of material is in Category _____ (A, B, or C).
d. If in Category A, has a Safety Summary been forwarded to (Answer Yes or No) Agency Contact _____. WSMR Safety Office _____.
e. If in Category B, was (Answer Yes or No to the following):
(1) It included in the Quarterly Tabular List? _____
(2) A copy of the Quarterly Tabular List forwarded to: Agency Contact _____; WSMR Safety Office _____?
(3) A Safety Summary for its use forwarded to WSMR Safety Office _____?

14. THE HAZARDS LISTED ABOVE ARE DESCRIBED COMPLETELY AND THERE ARE NO OTHER HAZARDOUS CONDITIONS ASSOCIATED WITH THIS TEST OPERATION.

Test Conductor _____ Date _____ Range Sponsor Tomas Katurra Date 28 May 81

STEWS NR-P FORM 1
19 Jul 78 (Rev)

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NATIONAL RANGE USERS HANDBOOK

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OPERATIONAL HAZARDS

1. DATE: 20 May 81			
2. PROGRAM TITLE: MILL RACE	3. VEHICLE NAME: ANFO	4. OR NUMBER: 96301	5. TEST DSG: MILL RACE
6. SERIAL NUMBER: DNA-MR-2	7. LAUNCH LOCATION GZM	8. IMPACT LOCATION: N/A	

9. ITEM	10. ITEM DESCRIPTION	11. LOCATION
1	600 Tons ANFO	Main charge
2	203 lbs New Octol	Main Booster assembly
3	24.5 lbs New Pentolite	Booster Insolation Sep.
4	Exp by Detonators	Detonators

12.

13. RADIOACTIVE HAZARDS

a. Is radioactive material used in this test? (Answer Yes or No) NO.
b. If 13a is Yes, is the use of the materials governed by NASC procedures? _____
c. If 13b is Yes, the quantity of material is in Category _____ (A, B, or C).
d. If in Category A, has a Safety Summary been forwarded to (Answer Yes or No) Agency Contact _____. WSMR Safety Office _____.
e. If in Category B, was (Answer Yes or No to the following):
(1) It included in the Quarterly Tabular List? _____
(2) A copy of the Quarterly Tabular List forwarded to: Agency Contact _____; WSMR Safety Office _____?
(3) A Safety Summary for its use forwarded to WSMR Safety Office _____?

14. THE HAZARDS LISTED ABOVE ARE DESCRIBED COMPLETELY AND THERE ARE NO OTHER HAZARDOUS CONDITIONS ASSOCIATED WITH THIS TEST OPERATION.

Test Conductor _____ Date _____ Range Sponsor Tomio Watanabe Date 28 May 81

SJLVS NR-P FORM 1
19 Jul 78 (Rev)

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NATIONAL RANGE USERS HANDBOOK

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PROGRAM TITLE: MILL RACE
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DATE: 20 May 81

2 & 3. TEST/MISSION OPERATIONAL REQUIREMENTS

2000. Test Operational Concepts

MILL RACE T-360 Minute Countdown

±TIME	EVENT	ACTIVITY
T-360	Meteorology Balloon Launch.	WSMR(MET)
T-300	Commence local countdown broadcasts at one hour intervals.	NO
T-270	Start signal dry runs.	IE
T-240	Establish internal road blocks, to control personnel on testbed.	PD
T-200	Establish communications with all sites and trailers (Use checkoff list).	NO (NET OPERATOR)
T-180	T&F report readiness to TGD.	IE
T-180	Meteorology balloon launch.	WSMR(MET)
T-180	Report to TGD readiness of instrumentation cameras.	WSMR OPTICS
T-150	Issue 30 minute warning for completion of signal dry runs.	IE
T-150	Open range net.	NO
T-150	Commence clearing the test bed by experimenters.	PD
T-150	Make test go ahead decision based on weather conditions.	TGD
T-150	Obtain WSMR permission to arm charge.	TGD
T-150	Report to TGD that firing circuit is safe.	IE

PROGRAM TITLE: MILL RACE
OR NO.: 96301
DATE: 20 May 81

T-140	Arming party enter test bed and start alignment of BIS.	SNL
T-130	Confirm experimenter personnel clear of test bed.	PD
T-120	Establish external (Rt 7) road blocks	WSMR(MP)
T-120	Phone test status to SAC, NWEF, and Learjet (Alamogordo).	PD
T-120	Complete signal dry runs.	IE
T-90	Confirm WAC takeoff from Socorro. Establish commo with Cessna N4681A on Test Control net.	Cherokee
T-75	BIS installation complete.	SNL
T-75	Commence test bed radar avoidance.	WSMR
T-75	Arming party request permission from TGD to arm charge.	SNL
T-75	Authorize arming of charge.	TGD
T-60	Meteorology balloon launch.	WSMR(MET)
T-60	NWEF confirm take off of A-7 from KAFB.	NWEF
T-60	Final experiment readiness check (Use checkoff list).	NO
T-55	Commence local countdown broadcasts at 5 minutes intervals.	NO
T-50	Surface wind report to TGD.	WSMR(MET)
T-45	Report arming complete. Arming party departs GZ and returns to T/F van.	SNL
T-45	Lift test bed radar avoidance.	WMR

PROGRAM TITLE: MILL RACE
OR NO.: 96301
DATE: 20 May 81

T-40	Manned station personnel accountability check.	All manned Sites
T-30	Confirm drone take off.	ARMTE
T-30	Learjet take off from Alamogordo.	
T-30	Confirm NWEF A-7 on station.	Cherokee
T-30	Confirm WAC in position over test bed.	Cherokee
T-30	Confirm arming party arrive at T/F van.	SNL
T-30	Report safety and security clear condition on test bed.	WSMR
T-15	Surface wind report to TGD.	WSMR(MET)
T-15	Confirm range green.	TGD
T-10	Begin countdown announcements at one minute intervals.	NO
T-10	Request permission from TGD to ready firing panel.	SNL
T-10	Direct firing panel ready.	TGD
T-5	Disable halogen fire protection system in vans.	Trailer Operator
T-5	Confirm firing panel is ready.	TD
T-4	Confirm Learjet attains working altitude of 3000' AGL.	Cherokee
T-3	MILL RACE test bed hold for drone synchronization.	TD
T-3	DFCS 30 second warning for drones at T-3 position.	WSMR(RCC)

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T-3	T/F confirm signal received from drones (discrete net).	TD
T-3	Resume countdown. Transfer control to TD.	TD
T-2.75	Start recorders.	T/F
T-90 Sec	NWEF start pressure transducer air drops.	NWEF
T-60 Sec	Commence 10 second countdown announcements.	NO
T-60 Sec	Confirm high voltage.	SNL
T-50 Sec	TRS sequence initiated.	T/F
T-30 Sec	Complete pressure transducer air drop.	NWEF
T-10 Sec	Commence one second countdown announcements.	T/F
T-10 Sec	TRS firing sequence commences.	T/F
T-0	Detonate charge.	T/F
T-0	Begin plus count.	NO
T+10 Sec	Net operator resumes plus count at 10 sec intervals.	NO
T+30 Sec	Safe firing system.	TD
T+1 Min	Re-establish internal road block. Report TGD.	PD
T+1	Provide plus count broadcasts at one minute intervals.	NO
T+1	Scheduled call in for manned station (Use check-off list.	All trailers
T+1	Report safing of firing system.	SNL
T+2	Reentry party assembled at internal road block.	PD

PROGRAM TITLE: MILL RACE
OR NO.: 96301
DATE: 20 May 81

T+3	Direct reentry party to proceed to test bed.	TGD
T+4	Learjet over test bed to start cloud track.	Cherokee
T+5	Reset halogen fire protection system in trailers.	Trailer Operators
T+5	Relay shot time to microbarograph operators.	NO
T+5	Meteorology balloon launch.	WSMR(MET)
T+5	Report to TGD TRS modules purged and safe.	TRS-PD
T+10	Provide plus count at 10 minute intervals.	NO
T+15	Report to TGD drone recovery.	ARMTE
T+15	Repor [illegible]arty reports test bed safe.	PD
T+15	Report classified experiments covered.	WSMR
T+15	Rope off debris collection areas.	CERF
T+20	Lift external road blocks.	WSMR(MP)
T+20	Commence removal of film.	WSMR OPTICS
T+30	Experimenter reentry by access list only.	PD
T+45	Commence guided tours.	PD
T+60	Report mission complete.	NWEF, Aerospace
T+60	Provide plus count at one hour intervals.	NO
T+60	Close range net.	NO
[redacted]		
T+300	Terminate plus count.	NO

(b)(3)

PROGRAM TITLE: MILL RACE
OR NO.: 96301
DATE: 20 May 81

2400. Air-Ground Voice Communications

a. One UHF radio is required for the on-site SAC Coordinator (Test Control Building). The frequency should be within the 225-400 MHz band at 100 watts maximum power. This equipment is required from 1 Sep 81 to 1 Oct 81.

b. Williamson Aircraft Photography will carry a radio tuned to the FCDNA WSMR radio frequency of 166.0 MHz.

c. The SNL aircraft delivering the instrument canisters will maintain radio contact with the MILL RACE event countdown. Radio frequency to be used will be determined at a later date from a separate OR.

d. AFTEC aircraft studying the dust cloud will maintain radio contact with the MILL RACE event countdown. Radio frequency to be used will be detemined at a later date. This aircraft will have VHF and UHF radio capability.

e. A VHF repeater for aircraft control purpose is required in the vicinity of Stallion Range Center to communicate with Williamson Aircraft during aerial photography documentation.

2600. Other Systems

See Addendum I for a tabular description of experimenters that are participating on MILL RACE.

2700. Ground Communications

a. Intercommunications. All intercommunications nets provide two way conversations between all stations.

(1) A discrete point to point intercommunications net between Test Control Bldg and the T&F Van is required.

(2) A discrete point to point intercommunications net between Test Control Bldg (A-1) and WSMR Range Control Center will be required for ready/hold status of test.

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(3) An instrumentation net with 19 standard units is required.

NET 2

AGENCY	LOCATION	BLDG #
Test Control	Admin Park	A1
WES	Inst Work Van	N6
BRL	Inst Work Van	N7
WESgm	Inst Van	N1
BRL	Inst Van	N2
AFWL	Inst Van	N3
AFWL	Inst Van	N4
FCDNA	TRS Work Van	S11
FCDNA	FCTEI Work Van	S12
BRL	Inst Work Van	S13
NAVY	Inst Van	S1
BRL	Inst Van	S2
BENDIX	T&F Van	S3
WSMR	Inst Van	S4
TRS	Inst Van	S5
Growth	Either of two Inst Park	5 Units

b. Telephones. A total of 18 lines, 23 extensions and 35 instruments will be required.

AGENCY	LOCATION	BLDG#	LINE#	TYPE	INTERCOM
FCDNA	Admin	A1	1a	Telecopier	
FCDNA	Test Control	A1	1	Desk	0
FCDNA	ADMIN	A1	2	Desk	0
FCDNA	Test Control	A1	-	Desk	0
FCDNA/FCTE	Admin Van	A2	3	Desk	2
WSMRFE	Admin Van	A2	4	Desk	2
WSMRFE	Admin Van	A2	-	Desk	2
FCDNA/FCTO	Admin Van	A3	-	Desk	3
FCDNA/FCTEI	Admin Van	A3	-	Desk	3
FCDNA/TRS	Admin Van	A4	-	Desk	4
FCDNA/FCTT	Admin Van	A4	-	Desk	4
FCDNA	Admin Conf Van	A8	-	Wall	5
NAVSEA	Admin Van	A6	5	Desk w/ext	6

PROGRAM TITLE: MILL RACE
OR NO.: 96301
DATE: 20 May 81

AGENCY	LOCATION	BLDG#	LINE#	TYPE	INTERCOM
FEMA/SSI	Admin Van	A6	6	Desk w/ext	6
WSMR	Admin Van	A7	7&8	Desk w/ext	7
WES/PAI	Admin Van	A7	-		7
BRL	Admin Van	A5	8&7	Desk w/ext	8
AFWL	Admin Van	A9	9&10	Desk w/ext	9
WES (Struc)	Admin Van	A10	10&9	Desk w/ext	10
BRL	Comp Van	A11	11&12	Desk w/ext	11
(Growth)	Admin Van	A12	12&11	Desk w/ext	12
N. Inst Park	Inst Work Vans	-	13&14	Wall w/ext	12
S. Inst Park	Inst Work Vans	-	15-17	Wall w/ext	12

Operators will be instructed that LCDR Gary Reid, USN, is the only person authorized to place toll calls on MILL RACE phones.

c. Public Address System. An outdoor public address system will be provided at the observation point. Location is yet to be determined (Probable location 2 miles east of Miller's Watch). Design will be dictated by location.

d. Ground/Ground Radio Communications.

(1) Forty-eight (48) radios with antennas will be provided by FCDNA for project use on this event. Installation of a base station with isoplane antenna (or equivalent) is needed at Test Control Building (A-1).

(2) A unit for monitoring the range net is required in the Test Control Building (A-1).

(3) AFWL will bring portable radios for use in fielding their experiments (139.625 and 139.975 MHz). DNA fielding personnel will also bring portable radios. WES plans to use a Corp of Engineers' frequency in their portable radios.

2800. Other Communications

Television. Extend safety TV system to include TV monitors placed at VIP viewing locations.

PROGRAM TITLE: MILL RACE
OR NO.: 96301
DATE: 20 May 81

3100. Photographic

a. Documentary Photography. Support will be required at the MILL RACE test site intermittently between 1 March 1981 and 1 November 1981. Public release of photography of the test bed or items thereon, regardless of who did the photography, will be authorized solely by the Test Group Director, MILL RACE, Field Command, Defense Nuclear Agency. Primary point of contact for all onsite coordination is Mr. E. Prather, MILL RACE Program Director. In his absence, coordination may be effected with the onsite MILL RACE representative. Objects to be photographed and fields of view will be specified at the test site.

(1) Still Photography

(a) The following is an estimate of total requirements:

TYPE	NO. EXPOSURES	SIZE PRINT	NO. PRINTS
Color	700	4 X 5	800
Color	3,500	8 X 10	7,000 (2 ea.)
Color	3,500	4 X 5	3,500 (1 ea.)
B & W	273	9 1/2 X 9 1/2	819 (3 ea.)

All negatives should be mailed to this address on or before October 1981:

Commander
Field Command, Defense Nuclear Agency
ATTN: FCTOH (MILL RACE)
Kirtland AFB, NM 87115

(b) The following is an estimate of workload by month:

	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
EXPERIMENTERS	0	0	75	339	119	570	2,479	30	30
FCDNA	50	50	75	75	100	100	200	35	0
TOTAL	50	50	150	414	219	670	2,679	65	30
Photographer Every Day					1	1	2		

(2) Motion Picture Photography

(a) All coverage will be of 16mm and in color. It is estimated that approximately 15,400 feet of film will be required.

(b) The following is an estimate of the workload.

MILL RACE MOTION PICTURE WORKLOADS

	APR	MAY	JUN	JUL	AUG	SEP	OCT
EXPERIMENTERS	0	0	400'	1,500'	2,600'	2,900'	0
FCDNA	500	500	1,000'	1,000'	1,500'	2,500'	1,000'
TOTALS	500'	500'	1,400'	2,500'	4,100'	5,400'	1,000'
Photographer permanently on site.						1	

b. Engineering Photography

(1) Time-correlated photography (high speed cameras ranging from 44,000 to 30 frames per second) is required to obtain cine photographs of the detonation fireball, surface-surge, shock wave expansions, and cloud formation and rise from zero time to approximately T+3 minutes. Cameras will be located in one of seven camera complexes. Four complexes at 4,000 feet from GZ will house 4 cameras photographing ejecta trajectories, and two streak film cameras photographing the booster initiation sequence. The three remaining camera complexes will be separated by 120° at 6,000 feet from GZ and house 25 cameras to look at the fireball, shockwave and cloud development. Four separate cameras will record the operation of the Thermal Radiation (TRS) modules. Addendum I lists requirements for each camera.

(2) For blast diagnostics WSMR will provide the necessary camera pedestals or platforms, protective covers, local timing, film and processing, all set up and operation, reference poles, data reduction and analysis report. The analysis report should address simultaneity of booster initiation, detonation velocity, uniformity of detonation, shock wave separation, fireball characteristics, cloud characteristics, shock or cloud anomalies, and shock wave velocity and amplitude.

PROGRAM TITLE: MILL RACE
OR NO.: 96301
DATE: 20 May 81

(3) Time-correlated photography (high speed cameras operating within the range of 24 to 2,000 frames per second) is required to photograph external and internal motions and damage mechanisms of vehicles, weapons systems, structures, electronic equipment, anthropomorphic dummies, and radio-controlled drones under the influence of a high-pressure shock wave, and the thermal radiation source. Due to the extremely high pressures to which some of the cameras will be subjected, protective camera mounts will be designed for maximum pressure up to 100 psi. All cameras will be DC-power operated. Local timing oscillators will be required for most cameras. Internal, high intensity lighting will be required for selected cameras. For engineering photography, WSMR will provide the necessary camera pedestals, protective covers, film and processing, all set up and operation, and data reduction as specifically requested. Addendum 1 lists requirements for each camera.

c. Motion Picture Reproduction

(1) Documentary. All cine footage should be developed into an original.

(2) Time-Correlated. Provide one (1) original of all footage. The number of prints required will be specified on-site. There will be a requirement for 8 X 10 prints of selected frames as specified by the Technical Director. It is estimated that this will total no more than 50 prints.

3200. Meteorological

a. Forecasts of high surface winds (in excess of 30 knots) and/or electrical storms in the Trinity area are required from T-18 days. Such forecasts warnings should be phoned to a MILL RACE representative at the Administration Trailer Park. A MILL RACE representative will call the duty weather forecaster, 678-1032/2605 by 1000 hours daily, when additional information is required. Routine general forecasts will be obtained by a MILL RACE representative over the phone at A/V 349-4183.

b. Specific meteorological support is required from WSMR in three other areas: rawindsonde balloon releases, surface observation data on specified days, and mobile monitoring station.

PROGRAM TITLE: MILL RACE
OR NO.: 96301
DATE: 20 May 81

(1) Rawinsonde balloon releases at T-6H, T-3H, T-1H and immediately after the shot (shot day only) for each dry run day and event day will provide air structure data. Critical temperatures, wind and pressure data is required on all releases and required at surface and 250 foot intervals up to 40,000 feet MSL. Launch site, if possible, should be within 10,000 to 15,000 feet of MILL RACE GZ. OTIM-3 site is acceptable.

(2) Surface observational data will be required on a continous basis from T-6H to T+1H on dry run and event days. Surface wind and direction, temperature, humidity and barometric pressure is required. Site is to be in operation 30 days before event day.

(3) Counter or desk space for one man is required in the meteorological support facility on T-1 day and event day.

c. Consultant services will be required about two months prior to event execution to detemine a time of day to execute the event which provides low surface winds with no temperature inversions or blast ducting conditions.

3400. Other Technical Support

a. Frequency Control and Analysis

Identification #	Radio Frequency	Purpose	Period of Use
1	166.00 MHz (AR Ser #Cal AA11)	Voice	1 May - 15 Nov 81
2	139.625 MHz	Voice	1 May - 15 Nov 81
3	139.975 MHz	Voice	1 May - 15 Nov 81
4	225 - 400 MHz	Voice (Ground Air)	1 Sep - 1 Oct 81

b. Geodetics

Beginning with D+1 a survey crew will be needed for 13 days to measure experiment locations.

PROGRAM TITLE: MILL RACE
OR NO.: 96301
DATE: 20 May 81

5300. Supply/Storage/Services

a. Security

(1) As test items are situated at the test area, it is required that beginning in May 1981 the Stallion Range Security Patrol include the MILL RACE test site in their security checks. Checks should include as a minimum, the main access roads to the test bed and trailer areas. Additional security requirements may result from the relocation of a high-value and/or pilferable items in the test that cannot be adequately protected. These requirements will be kept to a minimum and defined as soon as possible.

(2) Physical security (one guard post) will be required 24 hours per day at the test area when explosives are on site (planned from 1 Sep to 16 Sep 81).

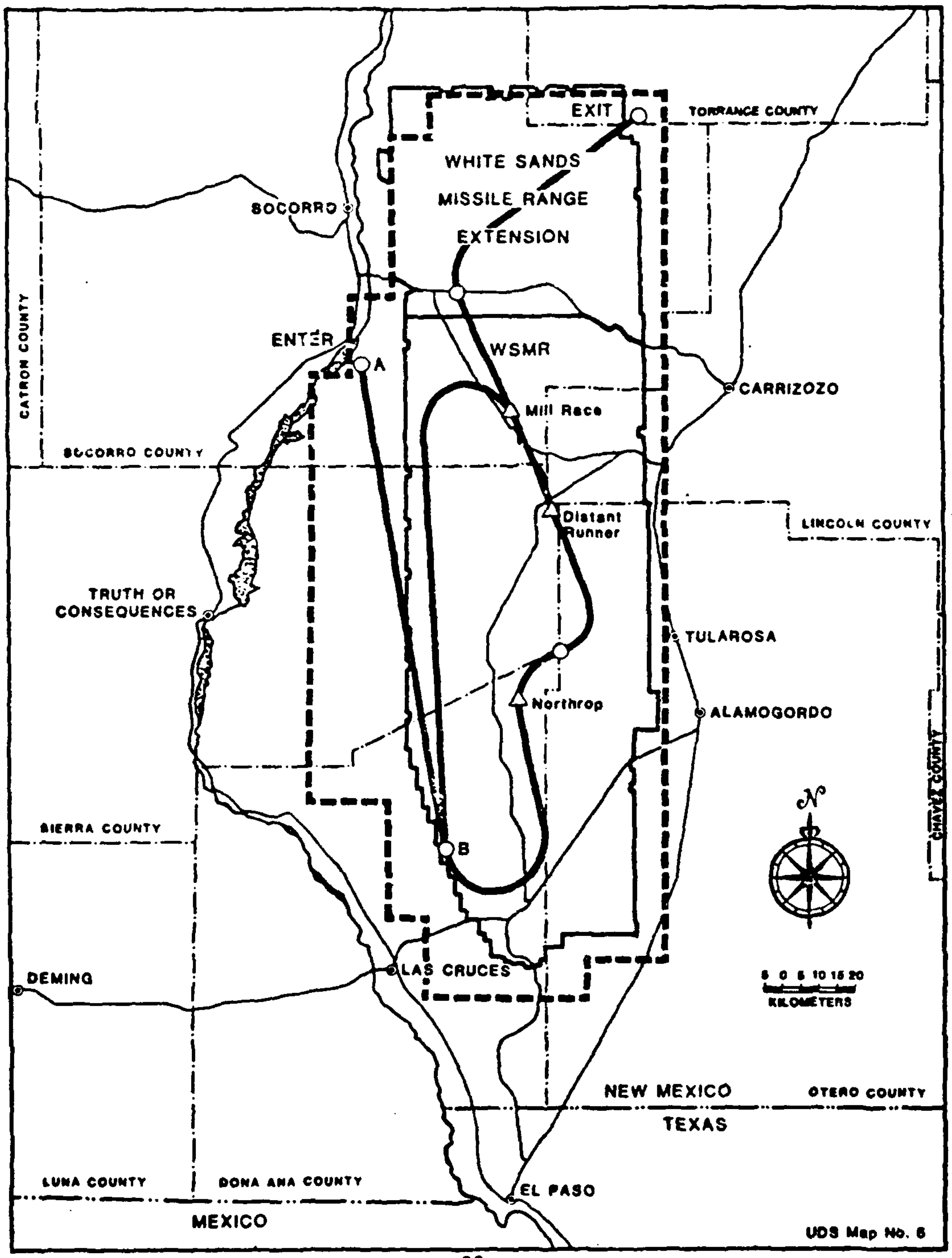
b. Fire Protection

(1) Normal fire protection services will be required during fielding operations. Potential fire hazards existing on the test bed will be identified and discussed with Chief, Stallion Range Center, Fire Station Number 3.

(2) Standby fire equipment and personnel should be available on event day at a location to be mutually agreeable between WSMR and FCDNA.

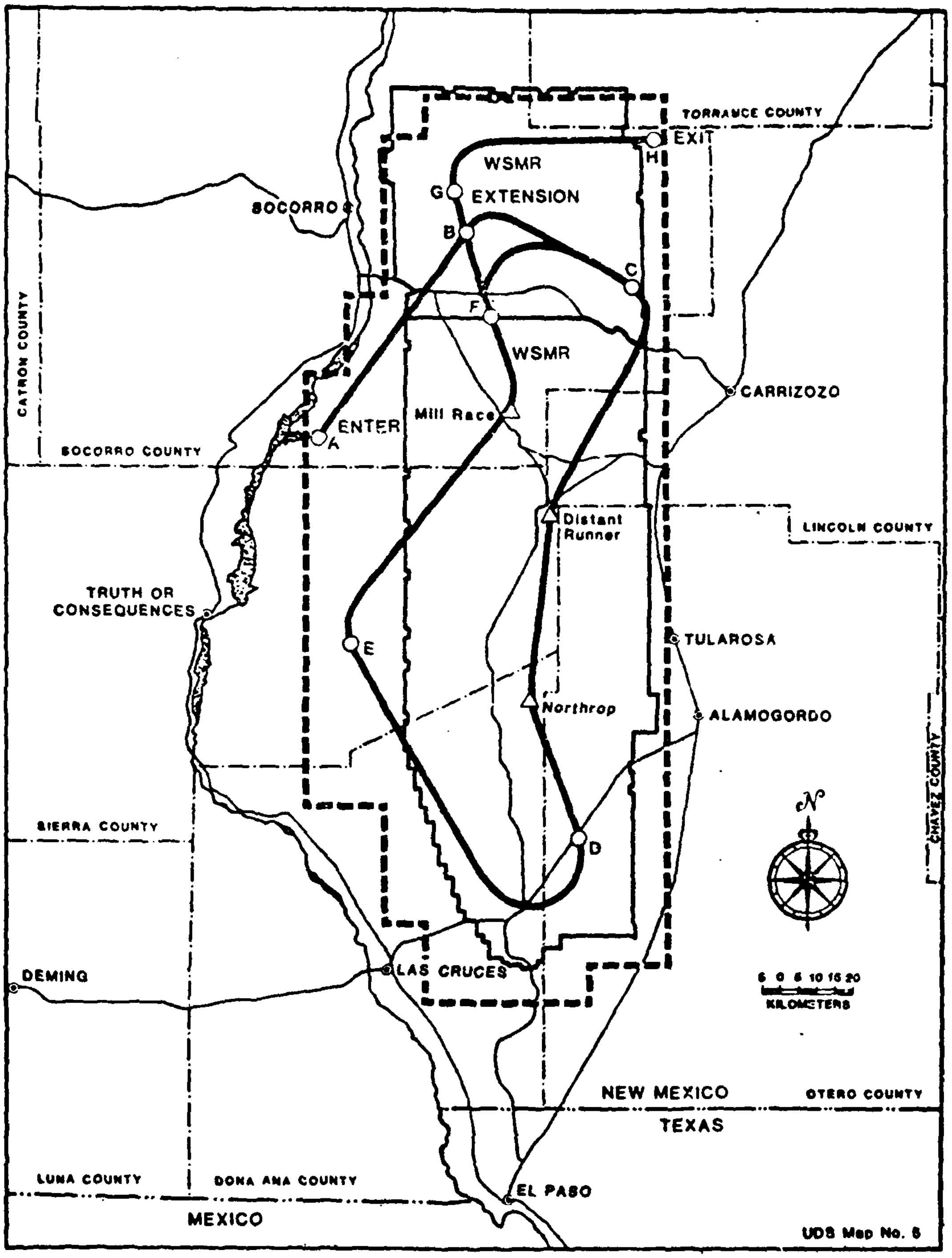
c. Maintenance

(1) On-call second and higher echelon maintenance is required for AC/heating units, electrical generators, motor-generators, isolation transformers, distribution skids, and vehicles. On-call facility maintenance for buildings within the test bed will be required. An electrician and air conditioning mechanic will be at South Instrumentation Park on shot day.



23

Mission Profile Route A B-52



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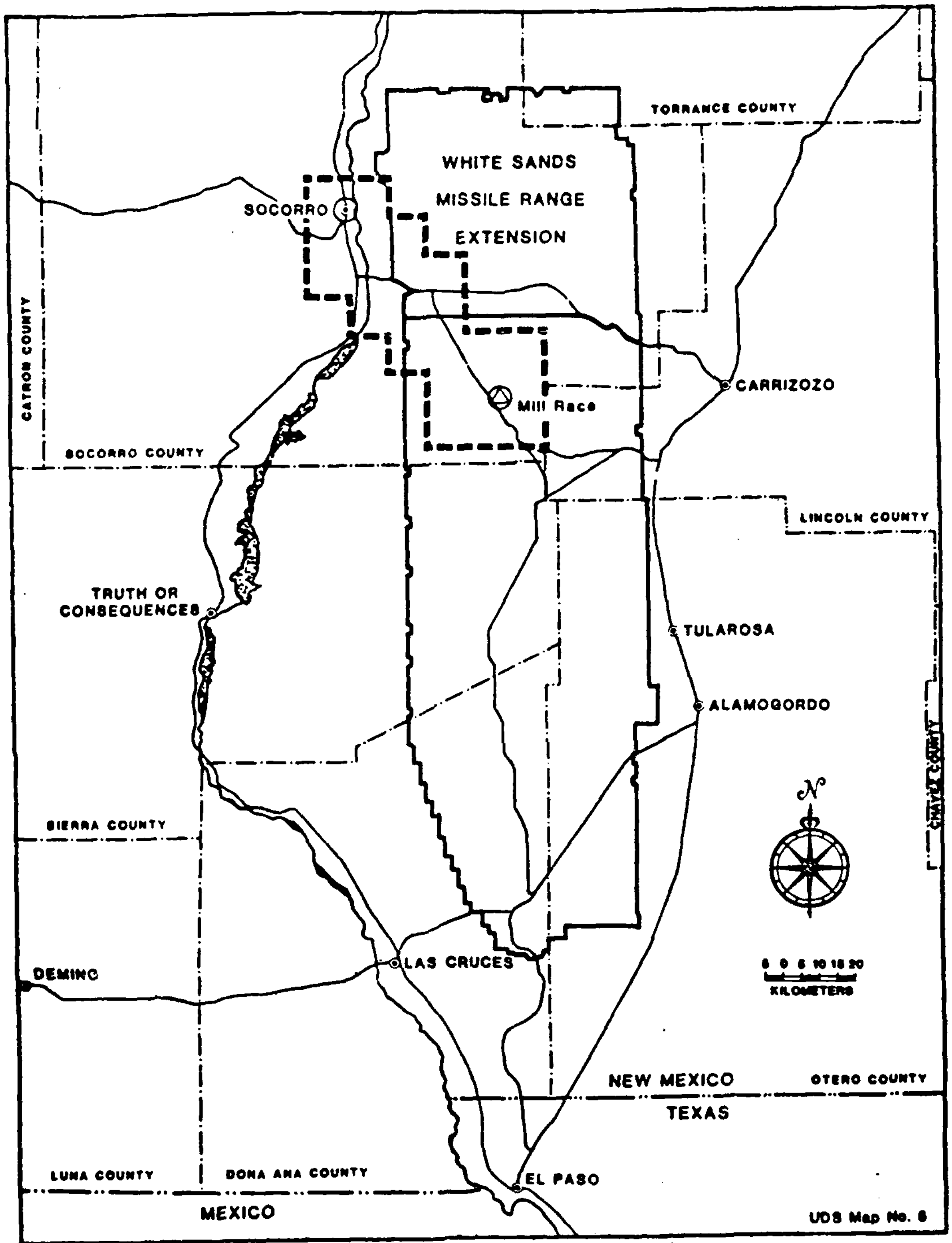
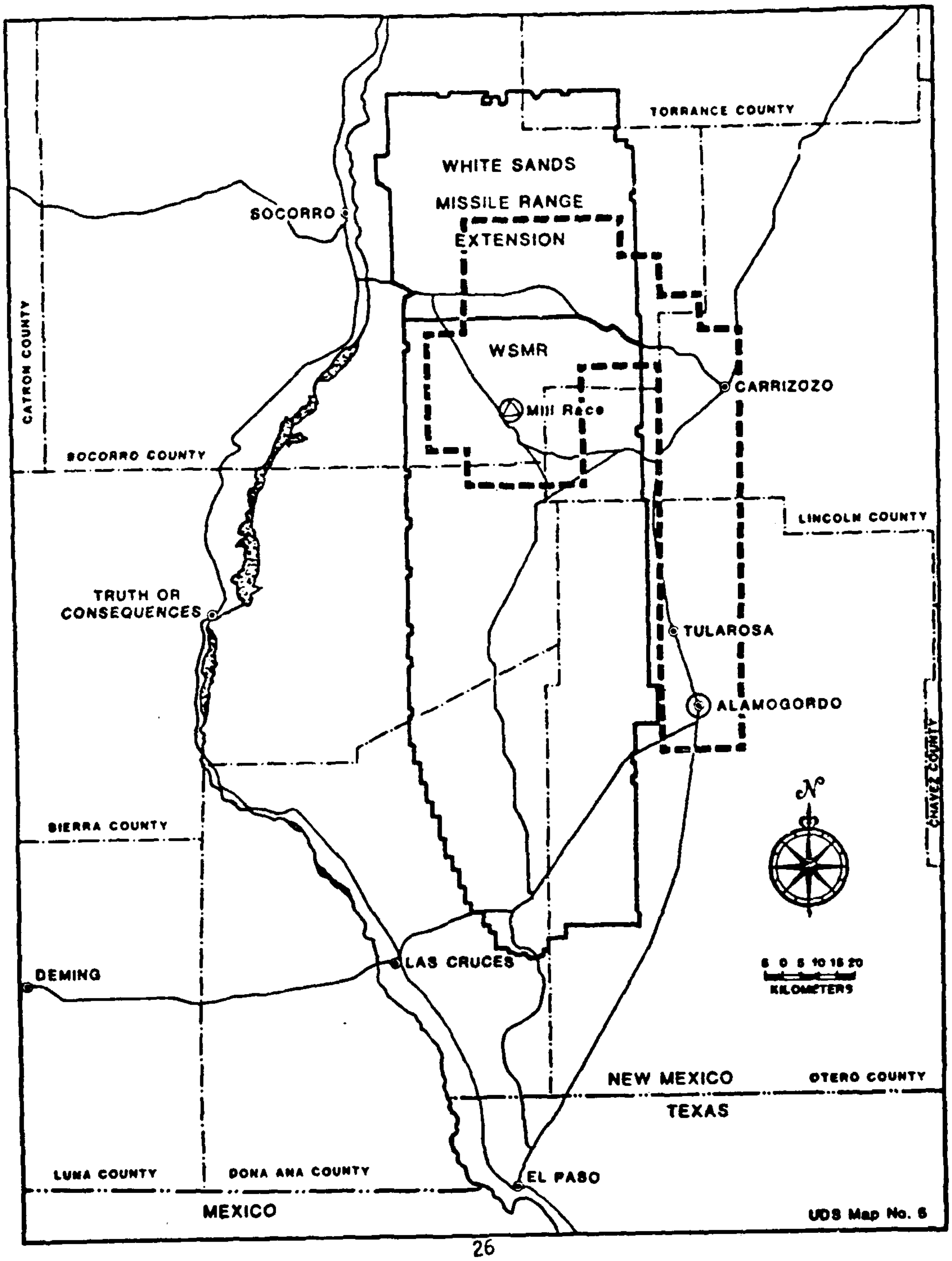
Mission Profile Route B, B-52



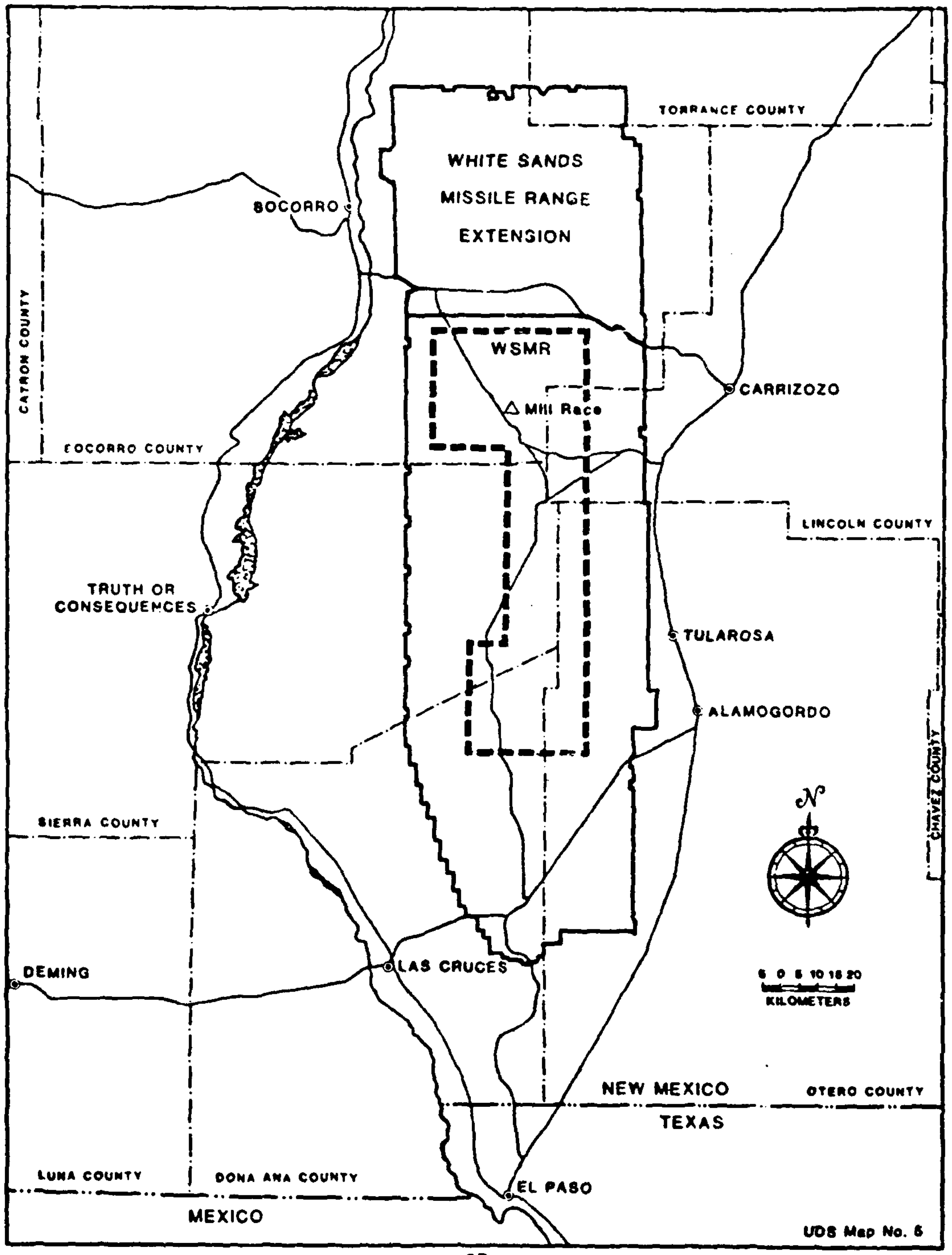
25

Mission Profile WAC Photo Plane



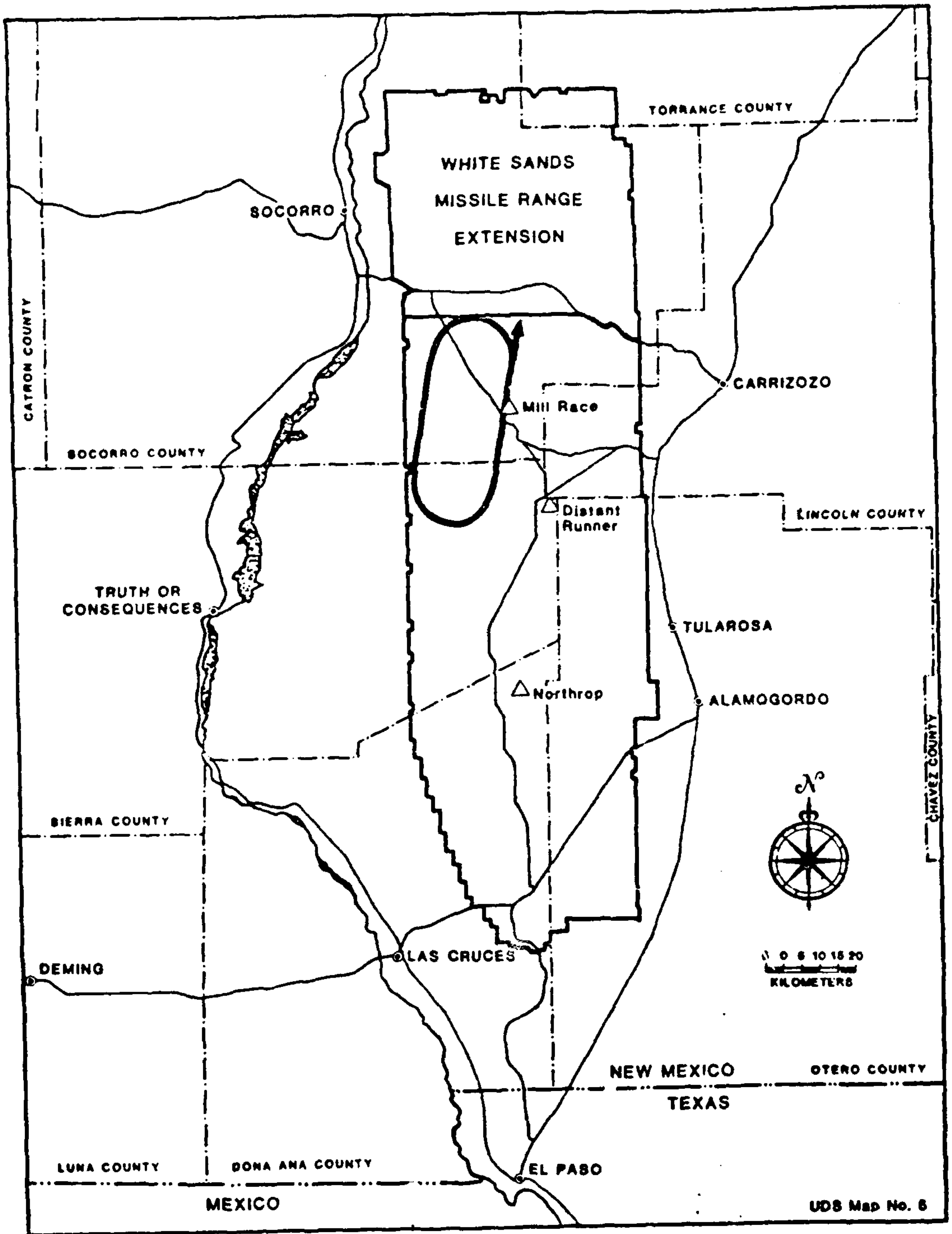
26

Mission Profile Learjet



27

Mission Profile F-86 Drones



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Mission Profile, A7

Addendum I

PROGRAM TITLE: MILL RACE

REV NO: ______

OR NO: 96301

DATE: ______

DATE: May 81

The following table describes the experimenters that are participating on MILL RACE.

Experiment Number	Controlling Organization	Measurement Devices/Facilities	Purpose	WSMR Support
2007, 2012, 2008, 2053-2058, 2009	BRL	Pressure, calorimeter acceleration and displacement gages, plus high speed cameras	Assess the vulnerability of tactical shelters and vans	3100, 5600
2071, 2081	BRL	Pressure transducer	Obtain blast damage data on protective shelter	5600, 3100
2301, 2302, 2303, 2305	STEWS-TE-AN WSMR, NM	Pressure, acceleration gages and high speed cameras	[redacted]	3100
2601, 2602	USA COE Waterways Experiment Station, Vicksburg, MS	Pressure, drag, strain accelerometers, velocity	Hardness test on industrial steel buildings	5600
3001, 3002, 3003, 3005	Naval Sea Sys Cmd Washington, DC	Pressure gages and calorimeters	Assess airblast/thermal hardness ship antenna	5600, 3100
3007	David W. Taylor Naval Ship R&D Ctr Bethesda, MD	Pressure gages and calorimeters	Assess airblast/thermal hardness deckhouse	5600, 3100
4001-4003	AFWL KAFB, NM	Pressure gages and accelerometers	[redacted]	5600, 3100
4101	AFWL	Pressure, drag	[redacted] airblast induced ground shock	3100

D4 (b)(3)

Experiment Number	Controlling Organization	Measurement Devices/Facilities	Purpose	WSMR Support
4401	AFWL	Pressure	Far-field measurements	- - -
4501, 4601	AFWL	Hardened cameras	Measure debris enhancement	3100
5001-5003, 5101-5103, 5201, 5301	FEMA Washington, DC	Pressure gages and accelerometers	Blast effects on shelters	3100
5401-5403	FEMA	High speed camera	Measure debris dispersal	3100
5501-3	FEMA	Calorimeters and cameras	Assess fire extinction by airblast	5600, 3100
6501	SNL	Pressure, accelerometers & temperature	Air drop pressure	- - -
7001	Sweden	Pressure gages and accelerometers	Measure response of fortification	5600, 3100
7501	[redacted]	N/A	[redacted]	3100
7601	AFTAC Patrick AFB, FL	Radiometers and cameras	Measure optical and EMP of blast	- - -
8001-8011	[redacted]	Calorimeters and high speed cameras	[redacted]	5600, 3100
8251	[redacted]	Pressure and calorimeters	[redacted]	5600, 3100
8301	[redacted]	Pressure sensors, accelerometers and anthropomorphic dummies, calorimeters	[redacted]	5600, 3100
8501-8502	[redacted]	Pressure	[redacted]	5600, 3100

D (b)(3)

Experiment Number	Controlling Organization	Measurement Devices/Facilities	Purpose	WSMR Support
9001	DNA Washington, DC	Pressure, drag, accelerometers	Ground motion	3100
9101, 9102	DNA	Cameras	Dust cloud measurements	3100
2251	Harry Diamond Lab 2800 Powder Mill Rd Adelphi, MD 20783	Passive		3100
2311	Lovelace Med Ctr Albuquerque, NM	Pressure sensors, accelerometers, high speed photography and anthropomorphic dummies	Obtain blast effects on US Army operationally oriented weapons systems	3100
8121, 8122	UK	Cameras	Blast effects	3100
6001, 6101, 6201	LANSL Los Alamos, NM	RF Pulses (Phase sounding)	Determine ionospheric response to acoustic shock	- - -
9401	DNA	Pressure	Test pressure gages	- - -
9103	DNA	Passive	Generic structures	3100
9901	DNA	Pressure gages	Airblast gages	
9902	DNA	Pressure gages	Elevated Air Blast	
9801	DNA	Passive	Cactus Coral Stress	- - -

APPENDIX B-2

OPERATIONS DIRECTIVE No. 9 6 3 0 1 A

MILL RACE

(PROGRAM SHORT TITLE)

OD NO. 9 6 3 0 1 A

OR TEST DESIGNATOR(S)	TEST TITLE
A	600 Ton ANFO Event

The support plan in this OD is based on the capability of the Range to provide support indicated, subject to availability when scheduled.

R. L. Meadows 578-1622

NR Project Engineer Telephone No.

FOR THE COMMANDER:

BART A. GOODE 7 August, 1981

Technical Director, NR DATE

THIS DOCUMENT IS CANCELLED WHEN NOT SCHEDULED WITHIN A TWO-YEAR PERIOD

WHITE SANDS MISSILE RANGE
NEW MEXICO

RMN

OD NO: 96301A	DISTRIBUTION	REVISION NO:
PARAGRAPH 1020		OR TEST DESIGNATOR(S): A

AA. 1

AFC 0

ATZC-MDMC-SE 1

CCNC-TWS. 10

DELAS-DP 2

FE-ER 1

LG-R 3

NR-AO 5

NR-CF 1

NR-CR 6

NR-CU 0

NR-D 8

NR-CS 2

NR-CS-DMA 1

NR-PD 6

NR-PR 1

PL 0

QA 1

DP-F. 1

DP-S. 1

<u>AIR FORCE</u>

AD-RUC. 1

Cdr, 6585 Test Gp, ATTN: AD-RUM,
Holloman AFB, NM 88330. 1

Cdr, 6585 Test Gp, ATTN: ATO,
Holloman AFB, NM 88330. 0

Cdr, Armt Div
ATTN: AD-TEPA, Eglin AFB,
FL 32542 0

Field Command, DNA. . . . . . .
ATTN: FCTOH
Kirtland AFB, NM 87115 10

TE 0

NOMTF 0

XX/OD No. 96301A	SECURITY CLASSIFICATION	REVISION No.
UDS PARAGRAPH: 1052		DATE:

PROGRAM TITLE: MILL RACE

USER SECURITY OFFICER: JOHN H. O'KIMA PHONE: 678-1161

CLASSIFICATION AUTH & DATE: MULTIPLE SOURCE

This page will require revision upon any pertinent change to the projects Security Classification Guide. Any temporary change caused by an incident resulting from a specific test will be reported to the WSMR Range Control Office immediately. The pre-printed continuation form page will be used for additional entries or remarks.

ITEM	Classi-fication	Declassification Date
A. RAW DATA		
1. Radar Tapes	U	
2. Telemetry Tapes	NA	
3. Cinetheodolite Film	NA	
4. Telescope Film	U	
5. Fixed Camera Film	S	Multiple Source
6.		
7.		
B. IN-TEST DATA (REAL TIME & ON-LINE)		
1. Trajectory Plots (Radar, RTDS, Etc.)	U	
2. Trajectory Tapes (Radar, RTDS, Etc.)	U	
3. Telemetry Plots (Oscillograms)	NA	
4. Telemetry Tapes (Digital)	NA	
5.		
6.		
C. POST-TEST DATA (QUICK-LOOK & VALIDATED)		
1. Trajectory ($x, y, z; \dot{x}, \dot{y}, \dot{z}; \ddot{x}, \ddot{y}, \ddot{z}$)	U	
2. Miss distance	NA	
3. Telemetry (Listings, Plots or Tapes)	NA	
4. Events or Time (Specify items)	U	
a.		
b.		
c.		
5. Geodetic Survey Computation (Specify items)	U	
a.		
b.		
c.		
D. FREQUENCIES	U	
1.		
2.		
E. DOCUMENTARY & AERIAL PHOTOGRAPHY		
1. Stills	S	Multiple Source
2. Motion Picture	S	Multiple Source
3.		
F. RECOVERY (List Classified items)	NA	
1.		
2.		
3.		
4.		
5.		
6.		

STEWS NR-P Form 16
1 Mar 79

1

NATIONAL RANGE USERS HANDBOOK

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

~~XX~~/OD No. 96301A	SECURITY CLASSIFICATION	REVISION No.
UDS PARAGRAPH: 1052		DATE:

PROGRAM TITLE: MILL RACE

ITEM	Classification	Declassification Date
G. RECOVERY AID (Information)	NA	
1. Radar Look Angle at ground impact point		
2. Radar range to ground impact point		
3. Optical Instrument look angle at impact point		
4. Telemetry look angle to loss of signal		
H. OTHER ITEMS	NA	
1.		
2.		
3.		

PAGE 2 of
STEWS NR-P Form 16
1 Mar 79

?

NATIONAL RANGE USERS HANDBOOK

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

NO: 96301A	OPERATIONS DIRECTIVE	REVISION NO:
UDS PARA		OR TEST DESIGNATOR(S): A

1100 PROGRAM AND TEST INFORMATION

a. Program Information

(1) User: Defense Nuclear Agency.

(2) Sponsor: NR-P, telephone, 678-1622.

(3) Priority: 3.

b. Test Information

(1) User Test Conductor: LCDR G. H. Reid, Field Command, DNA telephone 679-4183 duty or (505) 835-0510 after duty.

(2) User Control Point: Admin Park, MILL RACE Test Site, telephone 679-4183.

(3) Range Control Point: Bldg 300, Console 8 or 9, telephone 678-2221.

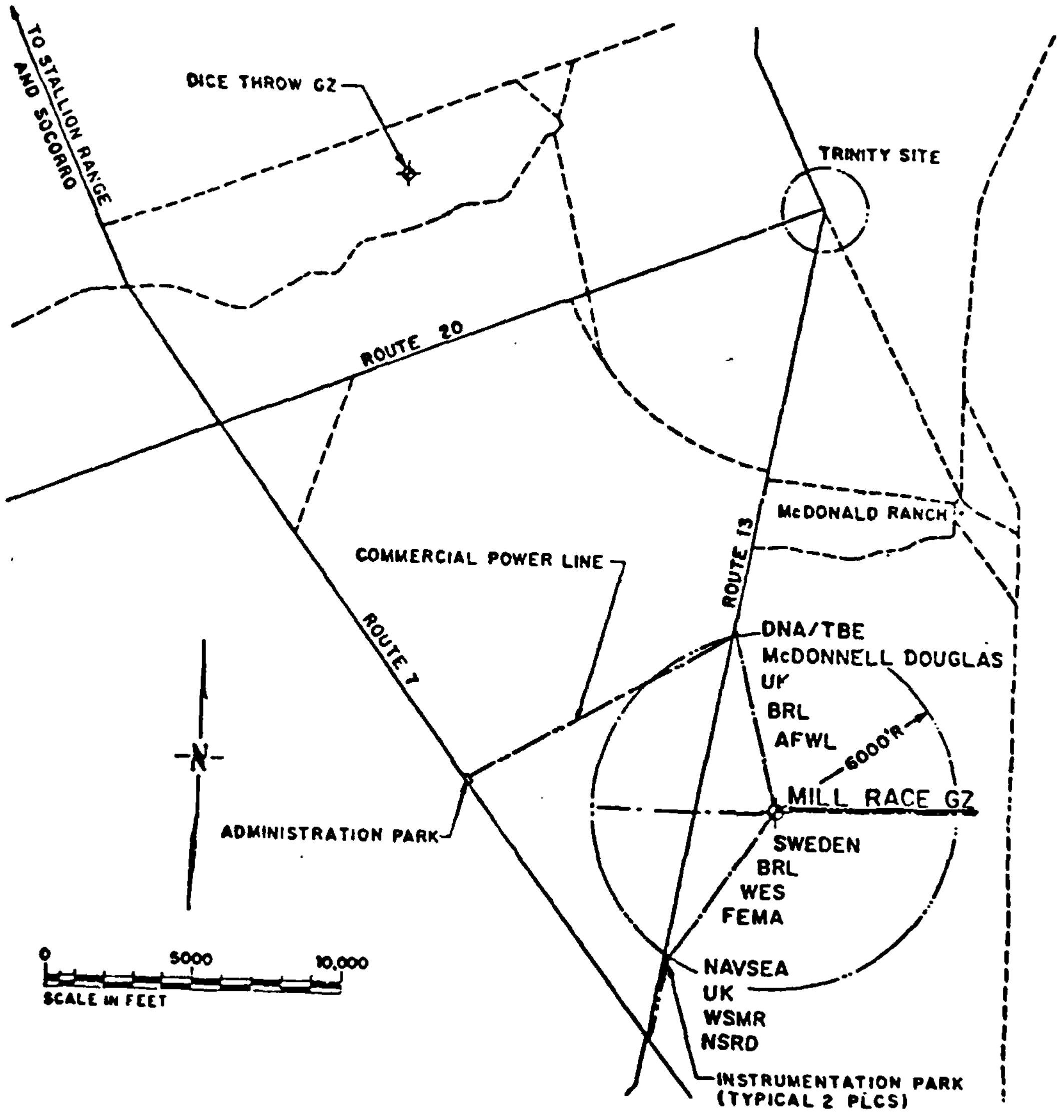
(4) OR Test Designator/OD Comparison

TEST DESIGNATOR	OD	Test Title
A	96301A	600 Ton ANFO Event

(5) Test Description: MILL RACE consists of one 600 ton high explosive event designed to provide a blast and shock environment for Department of Defense sponsored experiments utilizing scaled and unscaled shelters, and tactical and strategic systems and vehicles. Augmenting the blast environment will be a separate simultaneous thermal radiation source (TRS) providing a thermal environment for selected experiments. A series of ODs will be scheduled to accomplish the test. A four hour test window will be scheduled under OD 96301A which will include the event, TRS, Williamson Photo Aircraft (WAC) and Aerospace Photo Aircraft. OD 97916A will support the Sandia A-7 aircraft and canister drops. Two QF-86 drones will be scheduled under OD 96304A. Post test flights of six B-52 SAC aircraft will be scheduled under OD 96308A.

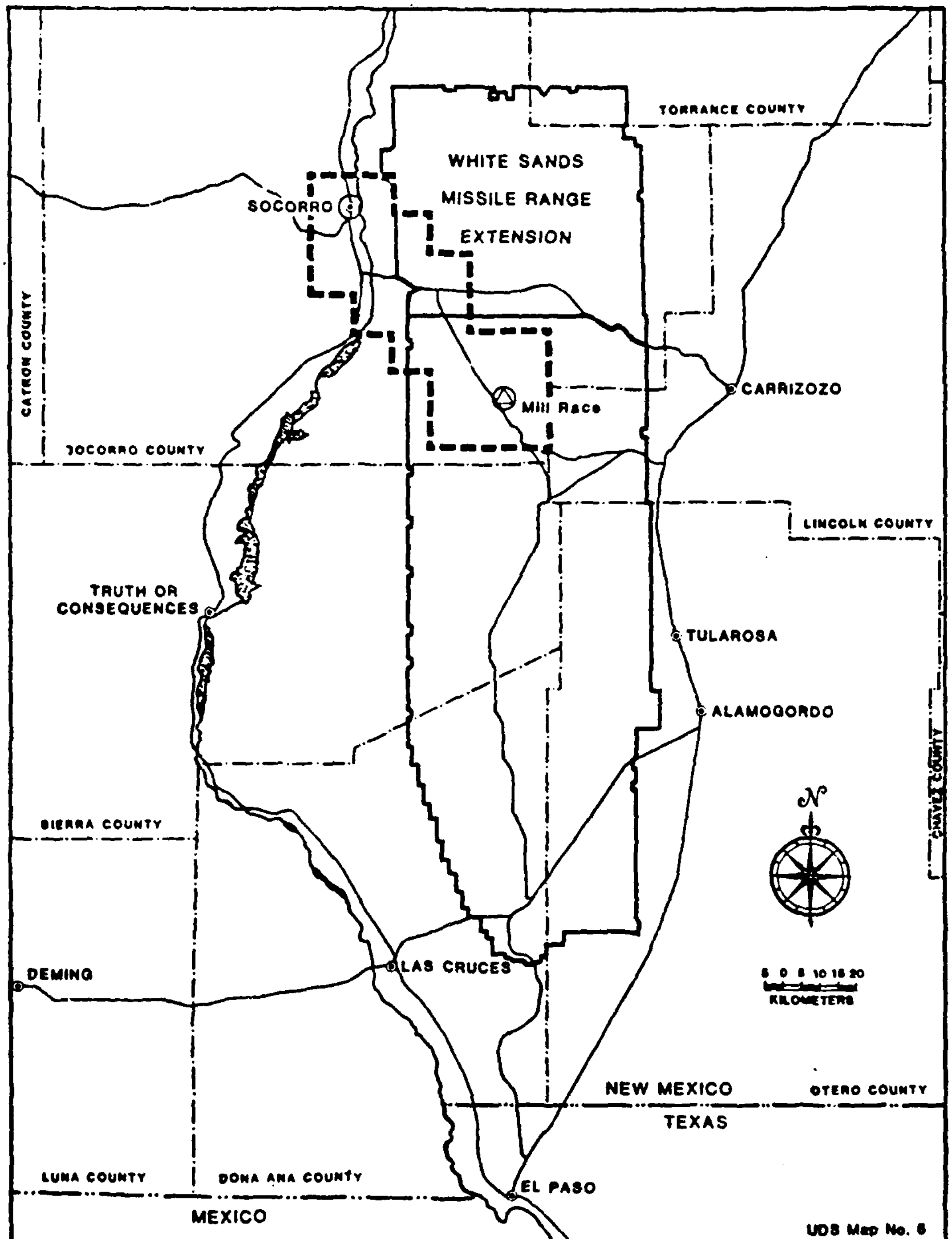
1700 TEST ENVELOPE INFORMATION

Refer to pages 4,5, and 6 for the test bed location and the air space requirements. Airspace maps on pages 7, 8, 9 and 10 are included for information only and will be scheduled under appropriate ODs.



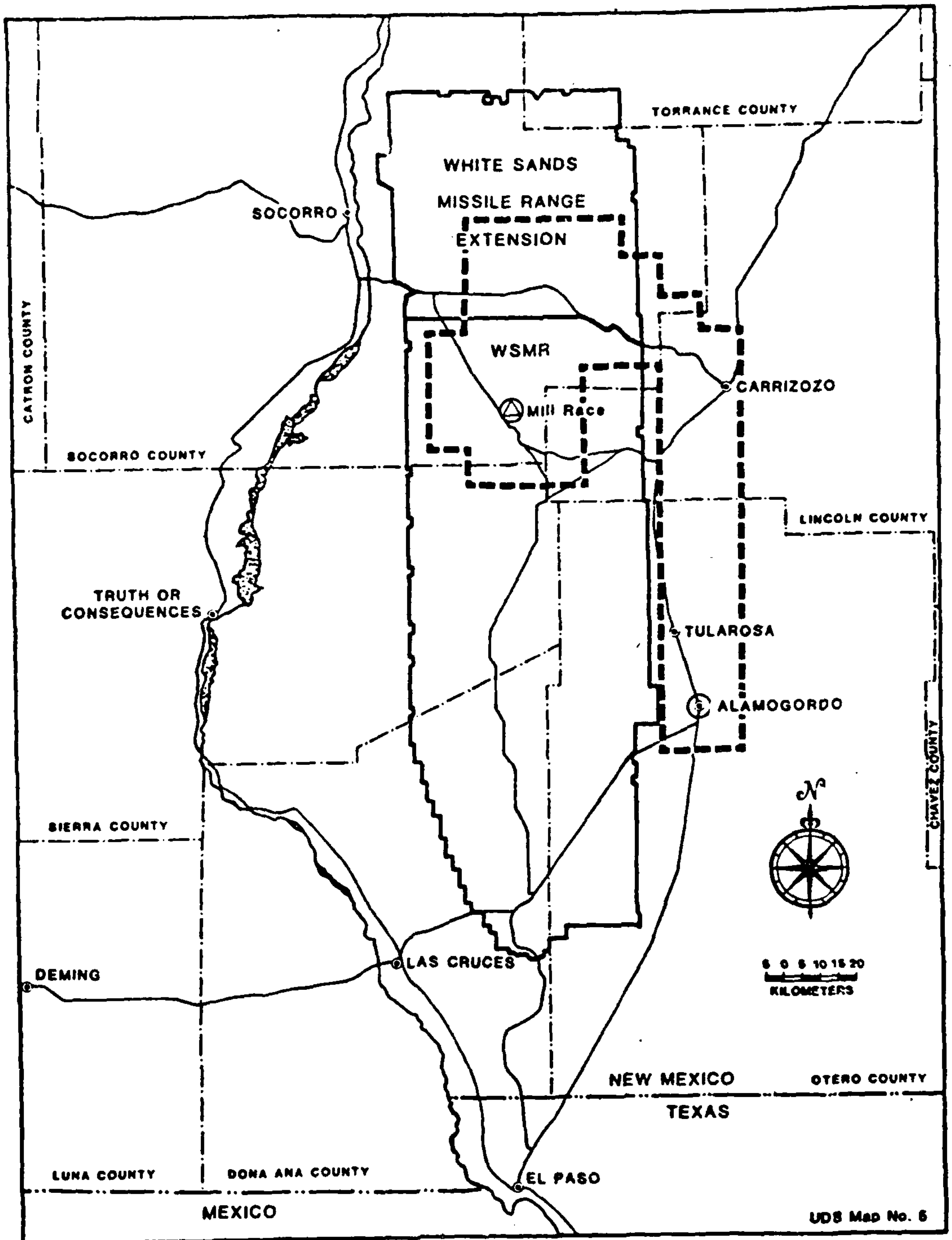
MILL RACE testbed location.

4



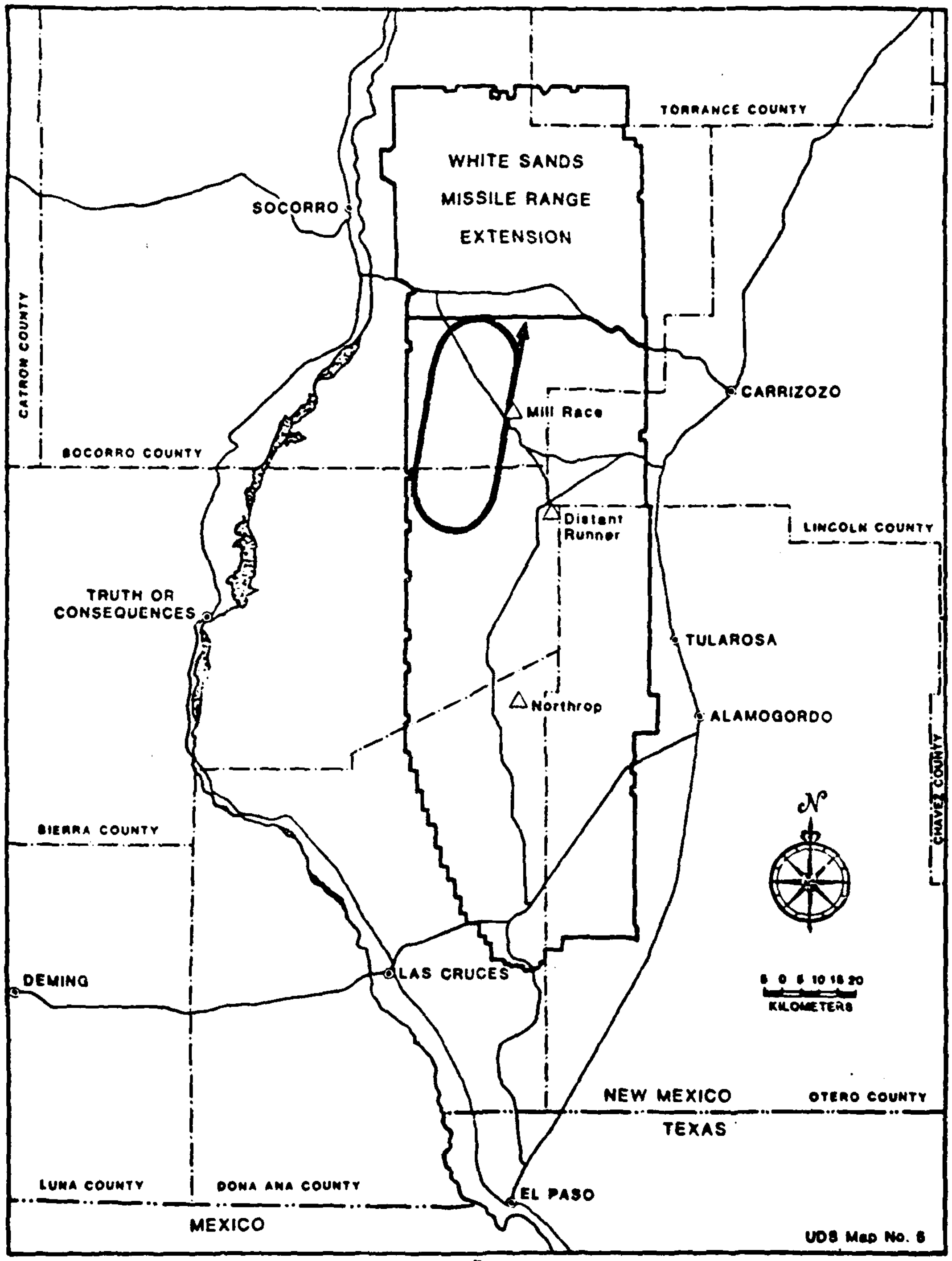
5

Mission Profile WAC Photo Plane



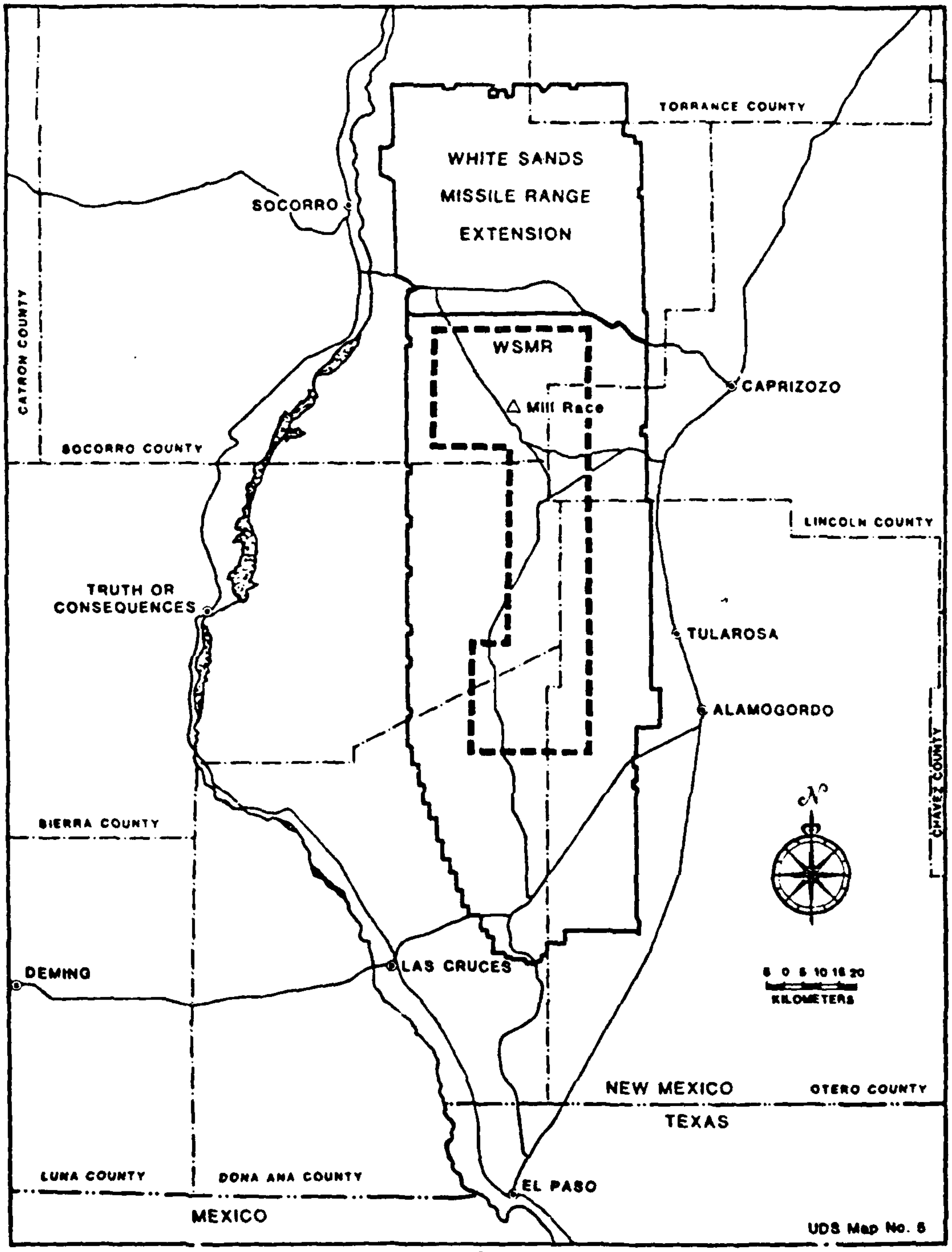
6

Mission Profile Learjet



7

Mission Profile, A7



8

Mission Profile F-86 Drones

Pages 244-245 deleted

NO: 96301A	OPERATIONS DIRECTIVE	REVISION NO:
ODS PARA		OR TEST DESIGNATOR(S): A

1800 OPERATIONAL HAZARDS

a. The operational hazards associated with this test are specified in the Operational Hazards Form (STEWS-NR-P Form 1) serial number DNA-MR-1 and DNA-MR-2, dated 20 May 1981.

b. Safety SOP #NR-PD-23-81, dated 3 April 81, will cover operations for this test.

2000 TEST OPERATIONAL CONCEPTS

Test Events

EVENT NO.	±TIME	EVENT
1	-7WD	User submits schedule to Range Scheduler.
2	-1WD	User briefs WSMR support elements.
3	-7Hrs	WSMR starts master countdown (MCD). See MCD beginning on page A-1.

2100 MEASUREMENTS AND DATA

a. Radar

(1) Sites/Assignments: R-127 will track the Learjet.

(2) Support: Transponder track Learjet and input to Bldg 300 computer.

(3) Data Priority: 1B.

Note: This radar will be supporting OD 96304A until the QF-86 has been handed back to mid range radars.

b. Optics

See pages of this document beginning with page B-1.

2400 AIR/GROUND VOICE COMMUNICATIONS

Air/ground radio communications in the frequency range of 225.0 to 399.9 MHz will be available from Bldg 300.

NO: 96301A	OPERATIONS DIRECTIVE	REVISION NO: OR TEST DESIGNATOR(S): A
UDS PARA		

2700 GROUND COMMUNICATIONS. The following will be provided:

a. Voice net 80146 between the Test Control Bldg and the T&F Van.

b. Range Command Net between the Test Control Bldg (A-1) and Bldg 300, OCDF.

c. Voice net 80145 at the following locations:

AGENCY	LOCATION	BLDG #
Test Control	Admin Park	A1
WES	Inst Work Van	N6
BRL	Inst Work Van	N7
WESgm	Inst Van	N1
BRL	Inst Van	N2
AFWL	Inst Van	N3
AFWL	Inst Van	N4
FCDNA	TRS Work Van	S11
FCDNA	FCTEI Work Van	S12
BRL	Inst Work Van	S13
NAVY	Inst Van	S1
BRL	Inst Van	S2
BENDIX	T&F Van	S3
WSMR	Inst Van	S4
TRS	Inst Van	S5
Growth	Either of two Inst Park	5 Units

d. Telephones at the following locations:

LOCATION	BLDG #	LINE #	TELEPHONE #	TYPE	INTERCOM
Admin	A1	1a	679-4153	Telecopier	
Test Control	A1	1	679-4183 (Rotary Key Sys)	Desk	0
ADMIN	A1	2	"	Desk	0
Test Control	A1	-	"	Desk	0
Admin Van	A2	3	"	Desk	2
Admin Van	A2	4	"	Desk	2
Admin Van	A2	-	"	Desk	2
Admin Van	A3	-	"	Desk	3
Admin Van	A3	-	"	Desk	3
Admin Van	A4	-	"	Desk	4
Admin Van	A4	-	"	Desk	4
Admin Conf Van	A8	-	"	Wall	5
Admin Van	A6	5	679-4334	Desk w/ext	6

NO: 96301A	OPERATIONS DIRECTIVE	REVISION NO:
UDS PARA		OR TEST DESIGNATOR(S): A

LOCATION	BLDG #	LINE #	TELEPHONE #	TYPE	INTERCOM
Admin Van	A6	6	679-4335	Desk	6
Admin Van	A7	7&8	679-4470/4471	Desk	7
Admin Van	A7	-	679-4470/4471	Desk	7
Admin Van	A5	8&7	679-4470/4471	Desk	8
Admin Van	A9	9&10	679-4254/4255	Desk	9
Admin Van	A10	10&9	679-4254/4255	Desk	10
Comp Van	A11	11&12	679-4418/4419	Desk	11
Admin Van	A12	12&11	679-4418/4419	Desk	12
Inst Work Vans	-	13&14	679-4162/4398	Wall	12
Inst Work Vans	-	15-17	679-4120/4344/4428	Wall	12

e. Public address system at the observation point (location to be determined). Notify TWS 48 hours before expected usage of system.

2800 OTHER COMMUNICATIONS

Television

System	Site	Assignments
V-0484	MILL RACE Van	Receive & Display TRS
	4k' west of Gz	" " "
	VIP area	Display from V-0482 and V-0483
V-0336	T-830 Northrup	Drone take-off & landing
V-0482	T-818	Drone Shockwave event
V-0483	T-788	" " "
V-0201	ATOM or SOP	Relay -V-0484, V-0482, V-0483
V-0236	Alamo Peak	Receive & transmit, V-0201, V-0336
V-0243	K-1	Receive & Display, V-0236

3000 REAL-TIME DATA DISPLAY AND CONTROL

a. A plot will be available in Bldg 300 to vector the Learjet aircraft.

b. The start signal will be generated by the 1108 for MILL RACE timing clock.

3100 PHOTOGRAPHY

Documentary still and motion picture photography will continue to be provided on request.

NO: 96301A	OPERATIONS DIRECTIVE	REVISION NO:
UDS PARA		OR TEST DESIGNATOR(S): A

3200 METEOROLOGY

a. Forecasts

(1) Standard WSMR 24 hour (teletype) forecasts will be available.

(2) Forecasts of high surface winds (in excess of 30 knots) and/or electrical storms in the Trinity area will be provided beginning T-18 days; and phoned to 679-4183.

(3) An updating of all forecast data can be obtained from the Duty Forecaster, 678-1032/2605.

b. Observations

(1) Surface

(a) Standard surface observations will be taken hourly at the SOTIM 3 Met Site from T-6H to T+1H on dry run and event days.

(b) Autographic recordings of temperature, relative humidity, pressure, and surface wind speed and direction in the test area will begin 30 days before event day.

(2) Upper Air - observational data will be provided from rawinsonde balloon releases at the SOTIM 3 Met Site (the AFSWC Met Site will be used as a back-up site) at T-6H, T-3H, T-1H and immediately after the shot (shot day only) on each dry run day and event day.

3400 OTHER TECHNICAL SUPPORT

a. Frequency Control and Analysis

(1) Station Plan

TYPE OF TEST	FSS OPERATIONAL SUPPORT WSMR	HOLLOMAN AREA
High Explosive Event	One	One

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UDS PARA		OR TEST DESIGNATOR(S): A

(2) Frequency Protection Plan. All usage of the following frequencies must be scheduled with the Range Scheduling Committee.

NOMENCLATURE OR FUNCTION	FREQ (MHz)	RFPC (±MHz)	AEB (kHz)	RFA
Range Radar	As Sched	5	8,000	WS 531
Range Radar	As Sched	5	18,000	WS 532
Transponder	As Sched	7.5	4,000	WS 532
A/G Comm	As Sched	0.075	6	WS 185 ADTC 66-77
Drone Arming DOE	409.475	0.04	160	18033469
Drone Arming DOE	412.7	0.04	160	18013164
A/G Comm	166.00	0.1	16	AA 111
G/G Comm Vega	149.600	0.1	16	WS 583
G/S Comm Vega	148.850	0.1	16	WS 583
G/G Comm	139.635 139.975			Requires RFA

b. Geodetics: Surveys will be provided.

4200 DATA DELIVERY AND DISPOSITION

a. Three tabulated copies (250 ft increments) of all rawinsonde data and 3 copies of all surface observational data and autographic charts will be sent to the following addressee:

Field Command, DNA
ATTN: FCTOH
Kirtland AFB, NM 87115

b. Data reduction of detonation, fireball, surface-surge, shock wave expansions, cloud formation, ejecta trajectories, and analysis of simultaneity of booster initiation, detonation velocity, uniformity of detonation, shock wave separation, fireball characteristics, cloud characteristics, shock or cloud anomalies, and shock wave velocity and amplitude will be provided. The user is requested to work closely with data analysis personnel during the data reduction period to assure the reports are complete and in an acceptable format.

OD NO: 96301A	MASTER COUNTDOWN & OPERATION LOG	REVISION NO:	PRIORITY: 3	SERVICE: 0	PAGE 1 OF 7
UDS PARAGRAPH 2000		OR TEST DESIGNATOR(S): A	OPN TITLE: 600 Ton ANFO Event		
OPN INDEX:	TEST DATE:	RANGE CONTROLLER:			

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
		STARTS TEST					
1	NR-CR	Mans Range Control Complex.	-07H 00M				
2	NR-CR	Checks communications. Range Controller contacts the user on range command net.	-06H 30M				
3	NR-CR	Counts in 5M increments to balloon launch.	-06H 15M				
4	NR-CR	Counts in 1M increments.	-06H 10M				
5	NR-CR	Counts in 10S increments.	-06H 01M				
6	NR-CR	Counts in 1S increments.	-06H 10S				
7	ASL	Releases balloon.	-06H 00M				
8	User	Picks up count in 1H increments.	-05H 00M				
9	User	Sets test bed roadblocks.	-04H 00M				Note: These roadblocks will be established to control traffic on the test bed.
10	User	Verifies test bed roadblocks set.	-04H 45M				
11	NR-CR	Counts in 5M increments to balloon launch.	-03H 15M				
12	NR-CR	Counts in 1M increments.	-03H 10M				
13	NR-CR	Counts in 10S increments.	-03H 01M				

STEWS-NR-P Form 25(Rev) 1 Aug 78   Replaces STEWS-NR-P Form 25, 1 Jul 73, which is obsolete.   STEWS-NR-P SOP 70-10c

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UDS PARAGRAPH 2000

MASTER COUNTDOWN & OPERATION LOG
(Continuation)

REVISION NO: OR TEST DESIGNATOR(S): A

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EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
14	NR-CR	Counts in 1[illegible] increments.	-03H 10S				
15	ASL	Releases balloon.	-03H 00M				
16	NR-CR	Obtains status report from NR-D.	-03H 00M				
17	NR-CR	Reports camera status to user.	-03H 00M				
18	NR-CR	Obtains status report from user.	-02H 30M				
19	User	Arrives at the OCDF.	-02H 30M				
20	User	Provides grid to the OCDF (Learjet aircraft).	-02H 30M				
21	User	Starts clearing test bed of experimenters.	-02H 30M				
22	User (IE)	Verifies firing circuit is safe.	-02H 30M				
23	User	Obtains permission from NR-CR to arm charge.	-02H 30M				
24	User (SNL)	Starts alignment of Booster Initiation System (BIS).	-02H 20M				
25	User	Verifies experimenters clear of test bed.	-02H 10M				
26	NR-CR	Directs DP-SP to set Hwy 7 roadblocks. (See also OD 96304A).	-02H 00M				
27	NR-CR	Starts RTDS.	-02H 00M				

STEWS-NR-P Form 25-1(Rev) 1 Aug 78   Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete.   STEWS-NR-P SOP 70-10c

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MASTER COUNTDOWN & OPERATION LOG (Continuation)

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EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
28	NR-CR	Starts radar static words.	-02H 00M				
29	NR-CR	Completes radar static words.	-01H 55M				
30	NR-CR	Starts radar slews.	-01H 55M				
31	NR-CR	Completes radar slews.	-01H 45M				
32	NR-CR	Starts radar static points.	-01H 45M				
33	NR-CR	Verifies Hwy 7 roadblocks set.	-01H 45M				
34	NR-CR	Completes radar static points.	-01H 40M				
35	NR-CR	Loads operational program.	-01H 40M				
36	RUM	Takes off from Socorro (WAC aircraft). Advises NR-CR when aircarft is air-borne.	-01H 30M				
37	NR-D	Starts Learjet aircraft transponder check.	-01H 30M				
38	NR-D	Directs radars to avoid test bed (R-127 & R-128).	-01H 20M				
39	User (SNL)	Completes alignment of BIS.	-01H 15M				
40	NR-CR	Verifies radar avoidance (R-127 & R-128).	-01H 15M				
41	User (SNL)	Starts arming charge.	-01H 15M				

STEWS-NR-P Form 25-1(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

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MASTER COUNTDOWN & OPERATION LOG (Continuation)

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EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS S	STATUS F	REMARKS
42	NR-CR	Counts in 5M increments to balloon launch.	-01H 15M				
43	NR-CR	Counts in 1M increments.	-01H 10M				
44	NR-CR	Counts in 10S increments.	-01H 01M				
45	NR-CR	Counts in 1S increments.	-01H 10S				
46	ASL	Releases balloon.	-01H 00M				
47	NR-D	Completes Learjet aircraft transponder check.	-01H 00M				
48	User	Starts final readiness check.	-01H 00M				
49	NR-CR	Checks communications. Range Controller contacts the user on range command net. NR-CR provides time check and checks ready-hold system.	-01H 00M				
50	User	Counts in 5M increments.	-55M 00S				
51	User (SNL)	Completes arming charge. Arming party returns to the Timing and Firing (T/F) Van.	-45M 00S				
52	NR-D	Lifts radar avoidance (R-127 & R-128).	-45M 00S				
53	User	Starts personnel accountability check.	-40M 00S				
54	User (SNL)	Verifies arming party at T/F Van.	-30M 00S				

STEWS-NR-P Form 25-1(Rev 1 Aug 72) Replaces STEWS-NR-P Form 25-1, 1 Jul 7?, which is obsolete. STEWS-NR-P SOP 70-10c

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MASTER COUNTDOWN & OPERATION LOG (Continuation)

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EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
55	User	Completes personnel accountability check.	-30M 00S				
56	User (TE)	Evacuates internal roadblock personnel to administration area.	-30M 00S				
57	OP-F	Verifies test bed clear.	-30M 00S				
58	RUM	Advises NR-CR when aircraft is air-borne.	-30M 00S				
59	NR-CR	Obtains status report from NR-A, TWS, NR-D, NR-CF and user.	-20M 00S				
60	NR-CR	Announces status of range.	-15M 00S				
		RANGE READY					
61	User (TE)	Verifies internal roadblock personnel in administration area.	-15M 00S				
62	User	Counts in 1M increments.	-10M 00S				
63	User	Readies firing panel.	-10M 00S				
64	User	Verifies firing panel ready.	-05M 00S				
65	User	Holds count for drone synchronization.	-03M 30S				

STEWS-NR-P Form 25-1(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

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EVENT NO	RESP ELEM	EVENT	T+TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
66	User	Picks up count upon receipt of signal from DFCS.	-03M 30S				
67	User	Counts in 10S increments.	-01M 00S				
68	User (SNL)	Verifies high voltage.	-01M 00S				
69	User	Starts thermal radiation source sequence.	-00M 50S				
70	User	Counts in 1S increments.	-00M 10S				
71	User	Detonates charge.	00M 00S				
		EVENT					
72	User	Provides a plus count in 1S increments.	+00M 01S				
73	User	Provides plus count in 10S increments.	+00M 10S				
74	User	Safes firing system.	+00M 30S				
75	User	Verifies firing system safe.	+01M 00S				
76	User	Provides plus count in 1M increments.	+01M 00S				
77	User	Re-establishes Test Bed roadblocks.	+01M 00S				
78	NR-CR	Counts in 1M increments to balloon launch.	+01M 00S				

STEWS-NR-P Form 25-1(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

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MASTER COUNTDOWN & OPERATION LOG
(Continuation)

REVISION NO: OR TEST DESIGNATOR(S): A

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
79	NR-CR	Vectors Learjet.	+02M 00S				Note: Radar R-127 requires 5 min turn around between drone hand off to acquiring Learjet.
80	NR-CR	Counts in 10S increments.	+04M 00S				
81	NR-CR	Counts in 1S increments.	+04M 50S				
82	ASL	Releases balloon.	+05M 00S				
83	User	Provides plus count in 10M increments.	+10M 00S				
84	User	Verifies test bed safe.	+15M 00S				
85	User (TE)	Verifies classified experiments are covered.	+15M 00S				
86	NR-CR	Lifts Hwy 7 roadblocks.	When Area Is Clear				
87	NR-CR	Lifts special roadblocks.	When Area Is Clear				
88	User	Provides plus count in 1H increments.	+01H 00M				
89	NR-CR	Releases WAC aircraft to Cherokee.	+ H M				
90	NR-CR	Releases Learjet aircraft to Cherokee.	+ H M				
91	User	Terminates plus count.	+05H 00M				
92	NR-CR	Terminates operation; releases supporting elements.	End of Range Time				
		TEST COMPLETE					

STEWS-NR-P Form 25-1(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

EXPERIMENT NUMBER	WSMR NUMBER	MOUNT	TYPE CAMERA	FRAME RATE	TIMING	COVERAGE SECONDS FROM	TO	ASSIGNMENT
2007	E-1660	Spec	16mm Nova	1000	OSC/Fidu	T-7	T+5	Inside wall nearest G-Zm
"	E-1661	Pipe	16mm Mill	400	OSC/FL	T-5	T+10	Front wall of truck
"	E-1662	"	"	"	"	"	T+10	Side & front of truck
"	E-1663	"	"	"	"	"	T+5	Side & front of truck (TRS light)
2008	E-1664	"	"	"	"	"	T+10	Side & front of truck
"	E-1665	"	"	"	"	"	T+10	" "
2012	E-1666	Spec	16mm Nova	1000	OSC/Fidu	T-7	T+5	Inside front wall of shelter
"	E-1667	Pipe	16mm Mill	400	OSC/FL	T-5	T+10	Front shelter wall
"	E-1668	"	16mm Nova	1000	"	"	T+10	Side & front wall
2053	E-1669	"	"	1000	"	"	"	Side & front van wall
2054	E-1670	"	"	"	"	"	"	" "
2057	E-1671	"	"	"	"	"	"	" "
2053	E-1672	"	16mm Mill	400	"	"	"	Rear van wall
2054	E-1673	"	"	"	"	"	"	" "

EXPERIMENT NUMBER	WSMR NUMBER	MOUNT	TYPE CAMERA	FRAME RATE	TIMING	COVERAGE SECONDS FROM	TO	ASSIGNMENT
2057	E-1674	"	16mm Mill	400	"	T-5	T+10	Rear van wall
2055	E-1675		16mm Nova	1000	"	T-5	T+10	Front & side van wall
"	E-1676	Spec	"	"	OSC/Fidu	"	"	Interior van ceiling
"	E-1677	"	"	"	"	"	"	Interior van wall
2056	E-1678	Pipe	"	1000	OSC/FL	"	"	Front & side van wall
"	E-1679	Spec	"	"	OSC/Fidu	"	"	Interior van ceiling
"	E-1680	"	"	"	"	"	"	Interior van wall
2058	E-1681	Pipe	"	1000	OSC/FL	"	"	Front & side van wall
2054	E-1682	Spec	"	"	OSC/Fidu	"	"	Interior van wall
5401	E-1687	"	"	1000	OSC/FL	"	"	Front & side wall bldg

EXPERIMENT NUMBER	WSMR NUMBER	MOUNT	TYPE CAMERA	FRAME RATE	TIMING	COVERAGE SECONDS FROM	TO	ASSIGNMENT
5401	E-1688	Pipe	16mm	1000	OSC/FL	T-5	T+10	Front & side wall bldg
"	E-1689	"	"	"	"	"	"	Side & rear wall bldg
5402	E-1690	"	"	"	"	"	"	Front & side wall bldg
"	E-1691	"	"	"	"	"	"	" "
"	E-1692	"	"	"	"	"	"	Side & rear wall bldg
5403	E-1693	"	"	"	"	"	"	Front & side wall bldg
"	E-1694	"	"	"	"	"	"	" "
"	E-1695	"	"	"	"	"	"	Side & rear wall bldg
5003	E-1696	Spec	16mm Locam	400	OSC/FL	T-5	T+12	Interior front wall & ceiling
5201	E-1697	"	16mm Mill	"	"	"	"	Interior ceiling
"	E-1698	"	"	"	"	"	"	Interior front wall
5501	E-1699	Pipe	"	1	--	"	T+60	
"	E-1700	"	16mm Nova	1000	OSC/FL	T-5	T+10	NOTE: These cameras are
5502	E-1701	"	16mm Mill	1	--	T-5	T+60	co-located (by twos) oriented
"	E-1702	"	16mm Nova	1000	OSC/FL	T-5	T+10	on fuel arrays in 10' X 10' Area
5503	E-1703	"	16mm Mill	1	--	T-5	T+60	

EXPERIMENT NUMBER	WSMR NUMBER	MOUNT	TYPE CAMERA	FRAME RATE	TIMING	COVERAGE SECONDS FROM	COVERAGE SECONDS TO	ASSIGNMENT
"	E-1704	"	16mm Nova	1000	OSC/FL	T-5	T+10	
2301	E-1705	"	16mm Mill	400	OSC/Fidu	T-5	T+10	Vehicle front view
"	E-1706	"	16mm Locam	"	"	"	"	Vehicle side view
2302	E-1707	"	"	"	"	"	"	" "
"	E-1708	"	16mm Mill	"	"	"	"	Vehicle front view
2303	E-1709	"	"	"	"	"	"	Vehicle side view
"	E-1710	"	"	"	"	"	"	Vehicle front view
2305	E-1711	"	"	"	"	"	"	Vehicle side view
"	E-1712	"	16mm Locam	"	"	"	"	Vehicle front view
4501	E-1715	"	"	300	OSC/FL	"	T+40	TBD
"	E-1716	"	"	"	"	"	"	"
"	E-1717	"	"	"	"	"	"	"
AFWL	E-1586	Spec Platform	16mm Hycam	5k	IRIG A	T-5	T+20	Fireball
"	E-1587	"	16mm Locam	200	"	"	"	"
Diagnostic	E-1713	"	16mm DynaFax	26k	Internal	T-0	T+0.8	Stack burn

EXPERIMENT NUMBER	WSMR NUMBER	TYPE MOUNT	TYPE CAMERA	FRAME RATE	TIMING	COVERAGE SECONDS FROM	COVERAGE SECONDS TO	ASSIGNMENT
4501	E-1716	Pipe	16mm Locam	300	OSC/FL	T-5	T+40	TBD
"	E-1719	"	"	"	"	"	"	"
3001 & 3007	E-1723	"	16mm Nova	1000	"	T-7	T+10	Deck house front & side
"	E-1724	"	16mm Nova	1000	"	T-5	"	"
8001 & 8010	E-1725	"	16mm Locam	400	"	"	T+12	Radome front view
8111	E-1726	"	16mm Locam	"	OSC/FL	"	"	Shelter front view
8251	E-1727	"	16mm Locam	"	OSC/Fidu	"	"	Tubes side view
"	E-1728	"	16mm Locam	"	"	"	"	Tubes front view
8301	E-1729	"	16mm Locam	"	"	"	"	Front view dummies
8501	E-1730	"	16mm Locam	"	OSC/FL	"	"	Tank front view
8502	E-1731	"	16mm Locam	"	"	"	"	" "

EXPERIMENT NUMBER	WSMR NUMBER	MOUNT	TYPE CAMERA	FRAME RATE	TIMING	COVERAGE SECONDS FROM	TO	ASSIGNMENT
9101	E-1734	Pipe	16mm Locam	24	OSC/FL	T-10	End of film	Test bed & G_z
8002	E-1735	"	16mm Locam	400	OSC/Fidu	T-5	T+12	Side & front redome
8003	E-1736	"	"	"	"	"	"	Front view radar
8003, 09	E-1737	"	"	"	"	"	"	Side view radar
9301	E-1738	Spec	16mm Mill	"	IRIG B	T-30	T+10	Tail view drone
"	E-1739	"	16mm Mill	"	"	"	"	" "
2601	E-1742	Pipe	16mm Locam	"	IRIG A	T-5	T+12	Side view of bldg
"	E-1743	"	16mm Locam	2000	"	T-2	T+7	Front & view of bldg
2602	E-1744	"	16mm Locam	"	"	"	"	" "
"	E-1745	"	16mm Locam	400	"	T-5	T+12	Side view of bldg
8008	E-1746	"	16mm Locam	400	OSC/Fidu/FL	"	"	Side view of pole mast
8011	E-1747	"	16mm Locam	"	"	"	"	Front view of Lchr
Diagnostics	E-1748	"	16mm Locam	250	OSC/Fidu	T-10	T+10	IRS UK-8
"	E-1749	"	16mm Locam	"	"	"	"	BRL

EXPERIMENT NUMBER	WSMR NUMBER	MOUNT	TYPE CAMERA	FRAME RATE	TIMING	COVERAGE SECONDS FROM	TO	ASSIGNMENT
Diagnos-tics	E-1750	Pipe	16mm Locam	250	OSC/Fidu	T-10	T+10	TRS UK-2
"	E-1751	"	"	"	"	"	"	Navy Deck/Antennas
2311	E-1752	Spec	"	200	"	T-5	T+12	Dummies in vehicles
"	E-1753	"	"	"	"	"	"	" "
"	E-1754	"	"	"	"	"	"	" "
"	E-1755	"	"	"	"	"	"	" "
"	E-1756	"	"	"	"	"	"	" "
Diagnostic	E-1759	Spec Platform	70mm 10-A	30	IRIG A	T-5	T+180	Cloud Growth
"	E-1760	"	70mm 10-A	"	"	"	"	" "
"	E-1761	"	70mm 10-A	"	"	"	"	" "
"	E-1762	"	70mm 10-B	360	"	T-6	T+12	Fireball, Shockwave

EXPERIMENT NUMBER	WSMR NUMBER	TYPE MOUNT	TYPE CAMERA	FRAME RATE	TIMING	COVERAGE SECONDS FROM	COVERAGE SECONDS TO	ASSIGNMENT
Diagnostic	E-1763	Spec Platform	70mm 10-B		IRIG A	T-6	T+12	Fireball, Shockwave
"	E-1764	"	70mm 10-B	"	"	"	"	" "
"	E-1765	Conc.	70mm 10-A	60	"	T-5	T+30	Ejecta Traj
"	E-1766	Conc.	70mm 10-A	"	"	"	"	" "
"	E-1767	"	70mm 10-A	"	"	"	"	" "
"	E-1768	"	70mm 10-A	"	"	"	"	" "
"	E-1769	Spec Platform	1/2 Fr 35mm	5000	"	T-4	T+6	Fireball, Surface Shock
"	E-1770	"	"	"	"	"	"	" "
"	E-1771	"	"	"	"	"	"	" "
"	E-1772	"	16mm Hycam	11000	"	T-7	T+1	Fireball
"	E-1773	"	16mm Hycam	"	"	"	"	"
"	E-1774	"	16mm Hycam	"	"	"	"	"
"	E-1775	"	1/4 Fr 16mm	44000	"	"	"	"
"	E-1776	"	"	"	"	"	"	"
"	E-1777	"	1/2 Fr 16mm	22000	"	"	"	"
"	E-1785	"	35mm	2500	IRIG A	T-4	T+6	Shockwave
"	E-1786	"	"	"	"	"	"	"

EXPERIMENT NUMBER	WSMR NUMBER	TYPE MOUNT	TYPE CAMERA	FRAME RATE	TIMING	COVERAGE SECONDS FROM	COVERAGE SECONDS TO	ASSIGNMENT
Diagnostic	E-1778	Spec Platform	1/2 Fr 16mm	22000	IRIG A	T-4	T+6	Fireball
"	E-1779	"	35mm	2500	"	"	"	Fireball, Shockwave, Ejecta
"	E-1780	"	35mm	2500	"	"	"	" " "
"	E-1781	"	"	"	"	"	"	" " "
"	E-1782	"	"	"	"	"	"	" " "
E-1783	Conc.	70mm CFA	122'/sec	"	"	T-2.5	T+1	Booster, Ignition
"	E-1784	"	"	"	"	"	"	" "
9102	E-1685	Tripod	16mm Locam	250	OSC/FL	T-5	T+20	SRI
"	E-1732	"	16mm Locam	"	"	"	"	"
9102	T-917	VTM	35mm	24	8	T-0	T+10m	Dust cloud
"	T-918	"	"	"	"	"	"	" "
"	T-752	"	"	"	"	"	"	" "
3007	E-1600	Pipe	16mm Nova	1000	Fidu	T-5	T+10	NAVSEA
2081	E-1603	"	15mm Nova	"	FL	"	"	BRL
"	E-1604	"	16mm Locam	400	"	"	"	"
"	E-1605	"	16mm Nova	1000	"	"	"	"
3001,07	E-1575	"	16mm Nova	"	Fidu	"	"	Side deck house
"	E-1577	"	16mm Nova	"	"	T-7	T+10	Front targets
"	E-1585	"	16mm Nova	2000	"	T-3	T+6	Oblique deckhouse

EXPERIMENT NUMBER	WSMR NUMBER	MOUNT	TYPE CAMERA	FRAME RATE	TIMING	COVERAGE SECONDS FROM	TO	ASSIGNMENT
3001,07	E-1634	Pipe	16mm Nova	1000	Fidu	T-7	T+10	Oblique Antennas
3002,03, 05	E-1606	"	16mm Nova	"	"	T-5	T+10	Side "
2602	E-1618	Int. Ped.	16mm Nova	2000	IRIG A	T-2	T+7	
Diagnostic	E-1617	Conc. Ped.	35mm 4-c	2500	IRIG A	T-4	T+[illegible]	
"	E-1635	Cam. Table	"	"	"	"	"	

APPENDIX B-3

OPERATIONS DIRECTIVE No. 9 6 3 0 4 A

MILL RACE

(PROGRAM SHORT TITLE)

OD NO. 9 6 3 0 4 A

OR TEST DESIGNATOR(S)	TEST TITLE
A	Dual Unmanned QF-86E Drone Flyby

The support plan in this OD is based on the capability of the Range to provide support indicated, subject to availability when scheduled.

for O.L. Meadows — 678-1622
NR Project Engineer — Telephone No.

FOR THE COMMANDER: for BART A. GOODE, Col — 31 Aug 81
Technical Director, NR — DATE

THIS DOCUMENT IS CANCELLED WHEN NOT SCHEDULED WITHIN A TWO-YEAR PERIOD

WHITE SANDS MISSILE RANGE
NEW MEXICO

EYC

OD NO: 96304A	DISTRIBUTION	REVISION NO:
PARAGRAPH 1020		OR TEST DESIGNATOR(S): A

AA. 1
AFC 0
ATZC-MDMC-SE 1
CCNC-TWS. 10
DELAS-DP 2
FE-ER 1
LG-R 3
NR-AO 5
NR-CF 1
NR-CR 6
NR-D 8
NR-CS 2
NR-CS-DMA 1
NR-PD 6
NR-PR 1
NR-CU 0
PL 0
QA 1
DP-F. 1
DP-S. 1

AIR FORCE

AD-RUC. 1

Cdr, 6585 Test Gp, ATTN: AD-RUM,
Holloman AFB, NM 88330. 1

Cdr, 6585 Test Gp, ATTN: ATO,
Holloman AFB, NM 88330. 0

Cdr, Armt Div
ATTN: AD-TEPA, Eglin AFB,
FL 32542 0

Field Command, DNA
ATTN: FCTOH
Kirtland AFB, NM 87115 10

HQ, Defense Nuclear Agency
ATTN: SPAS
Washington, DC 20305 2

KAMAN Avidyne
ATTN: DR. J. R. Rutenik
83 Second Avenue
North West Industrial Park
Burlington, MA 01803 2

TE-MF 15

NOMTF 0

NO: 96304A	OPERATIONS DIRECTIVE	REVISION NO:
UDS PARA		OR TEST DESIGNATOR(S): A

1100 PROGRAM AND TEST INFORMATION

a. Program Information

(1) User: Defense Nuclear Agency.

(2) Sponsor: TE-MF, telephone 678-2018.

(3) Priority: 3.

b. Test Information

(1) User Test Conductor: Mr. Normand, telephone 679-9525.

(2) User Control Point: QF-86 Operations, Northrup Strip.

(3) Range Control Point: Bldg 300, Console 8 or 9, telephone 678-2221.

(4) OR Test Designator/OD Comparison

TEST DESIGNATOR	OD	Test Title
A	96304A	Dual Unmanned QF-86E Drone Flyby

(5) Test Description: Two unmanned QF-86E's will take-off and land at Northrup Strip under control of the Mobile Ground Station (MGS). Aircraft will take off and will be handed off to DFCS Control thru the Fixed Ground Station (FGS). The DFCS will fly the aircraft thru a formation racetrack over the 90 mile area.

(6) Security Classification: No classified data will result from tests conducted under this OD.

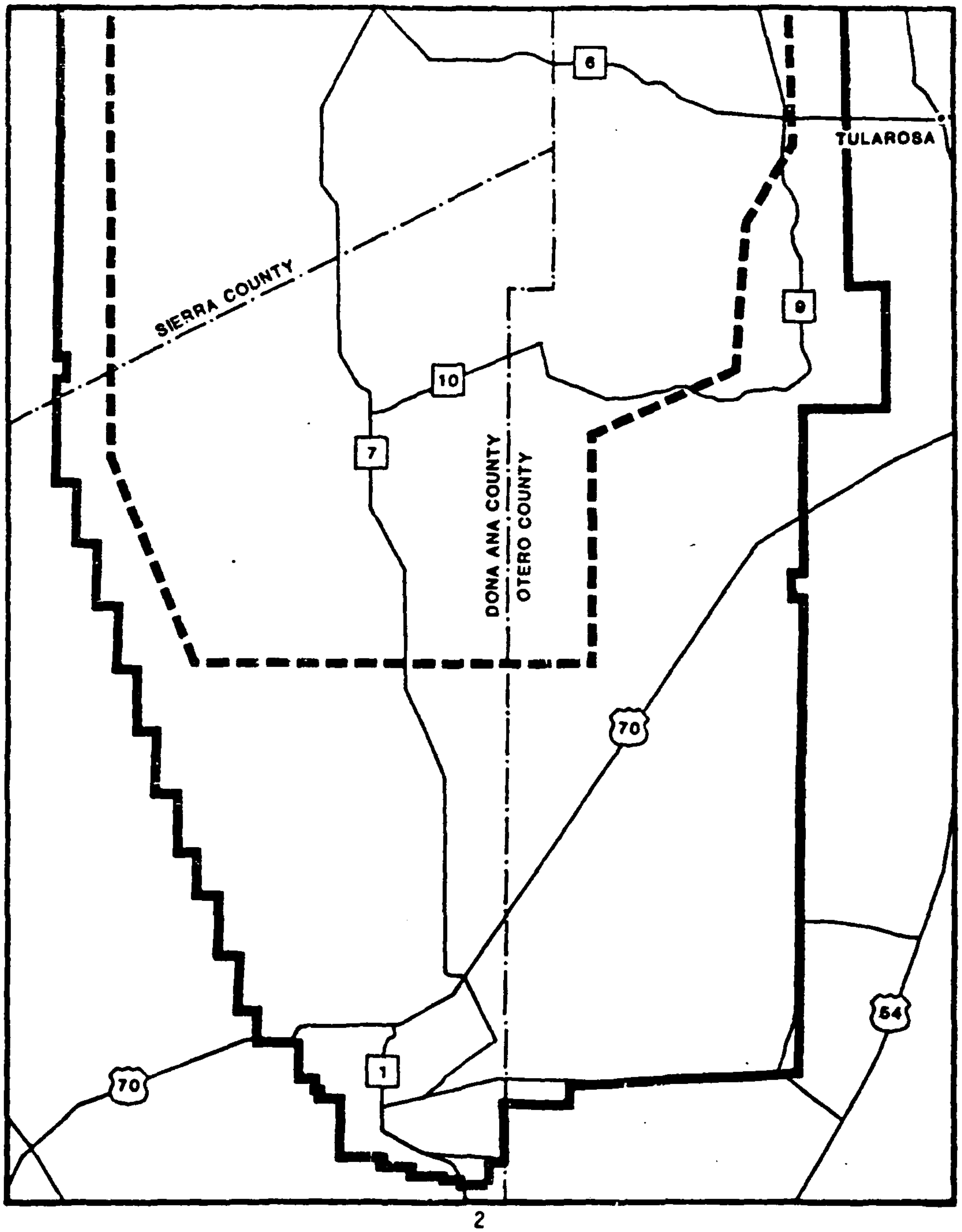
(7) Operating, support and data limitations

UDS PARA	LIMITATION
2000	1. Either QF-86E will be destroyed at the discretion of the MFTSM if it crosses the safety boundary, endangers a sensitive area, or if, in his judgement, continuation of the flight will create a hazardous situation.
	2. Any manned aircraft employed in conjunction with this test must remain at all times a safe distance from the drones, as WSMR cannot guarantee warning of a destruct action.
	3. QF-86E's may not exceed safety boundary shown on maps on pages 2 and 3.

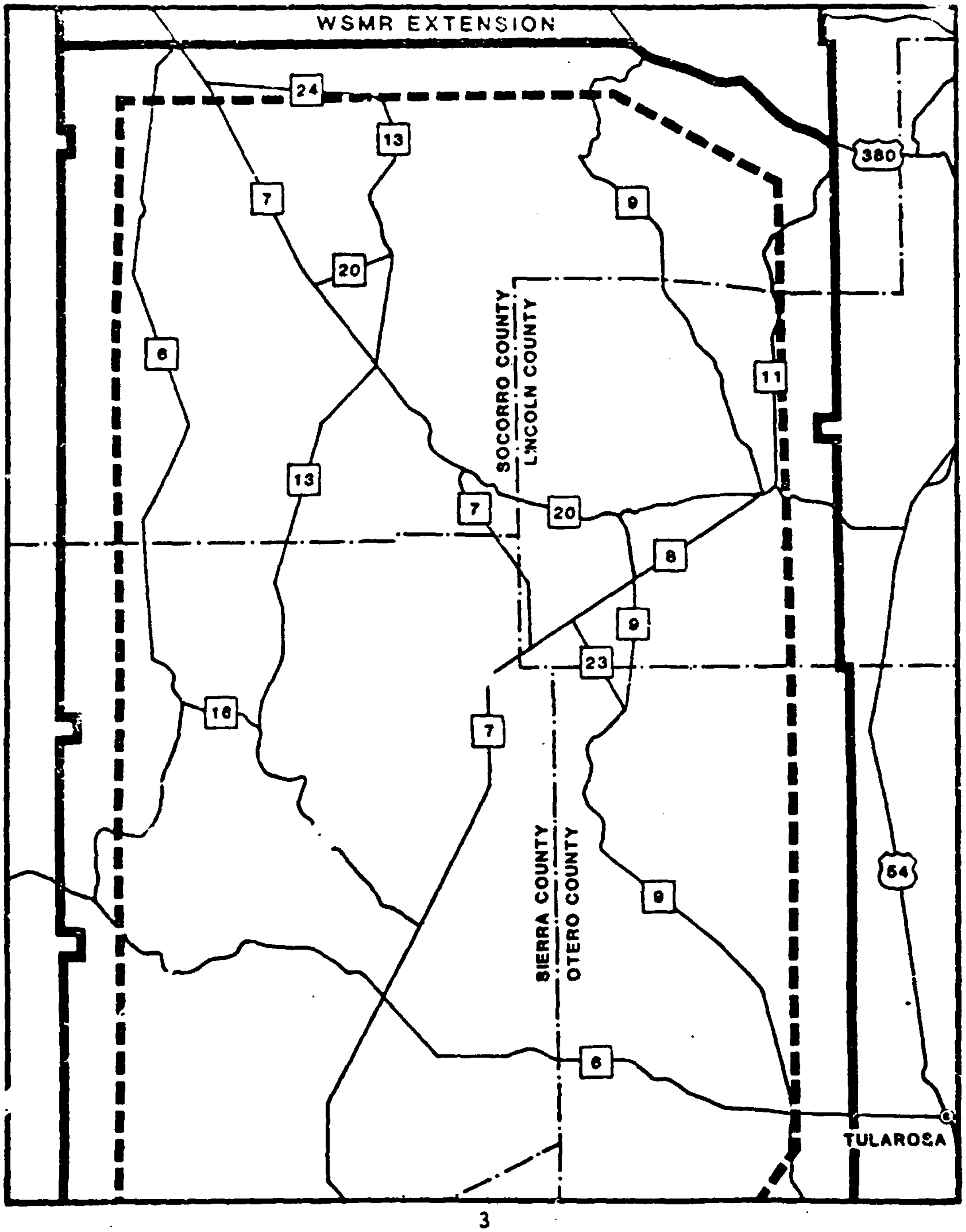
1700 TEST ENVELOPE INFORMATION

a. Test Limits - QF-86E Targets.

(1) Failsafe timer setting not to exceed 9 seconds.



F-86 Drone Safety Boundary



F-86 Drone Safety Boundary

NO: 96304A	OPERATIONS DIRECTIVE	REVISION NO:
UDS PARA		OR TEST DESIGNATOR(S): A

(2) Target heading prior to intercept: 164°T ± 1°.

(3) Target speed: 400 FPS.

b. Air Space Operations: Air space operations are shown on UDS Map 5 on page 5. Flight profile is shown on pages 6 and 7.

1800 OPERATIONAL HAZARDS

STEWS-NR-P Form 1 #TGT-FSI-1 and #TGT-FSI-2 apply for the QF-86E flights.

2000 TEST OPERATIONAL CONCEPTS/SUMMARIES

a. Test Events

EVENT NO	±TIME	EVENT
1	Mid Month	User submits monthly forecast.
2	-6CD	User submits schedule request.
3	-1WD	User briefs WSMR support elements.
4	-6Hr	WSMR starts master countdown (MCD). See MCD beginning on page A-1.

b. Flight Safety Operations Concepts/Summaries

(1) Termination Method

The failsafe system is enabled by Vega, DFCS, and UHF uplink command shortly after takeoff and includes a delay timer which is activated by any of the failsafe conditions and resets automatically upon correction of these conditions prior to timer expiration. This delay timer must be adjusted to a value such that the elapsed time from interrogation loss to destruct does not exceed 5 seconds for UHF and Vega LOC and 9 seconds for UHF, Vega and DFCS LOC.

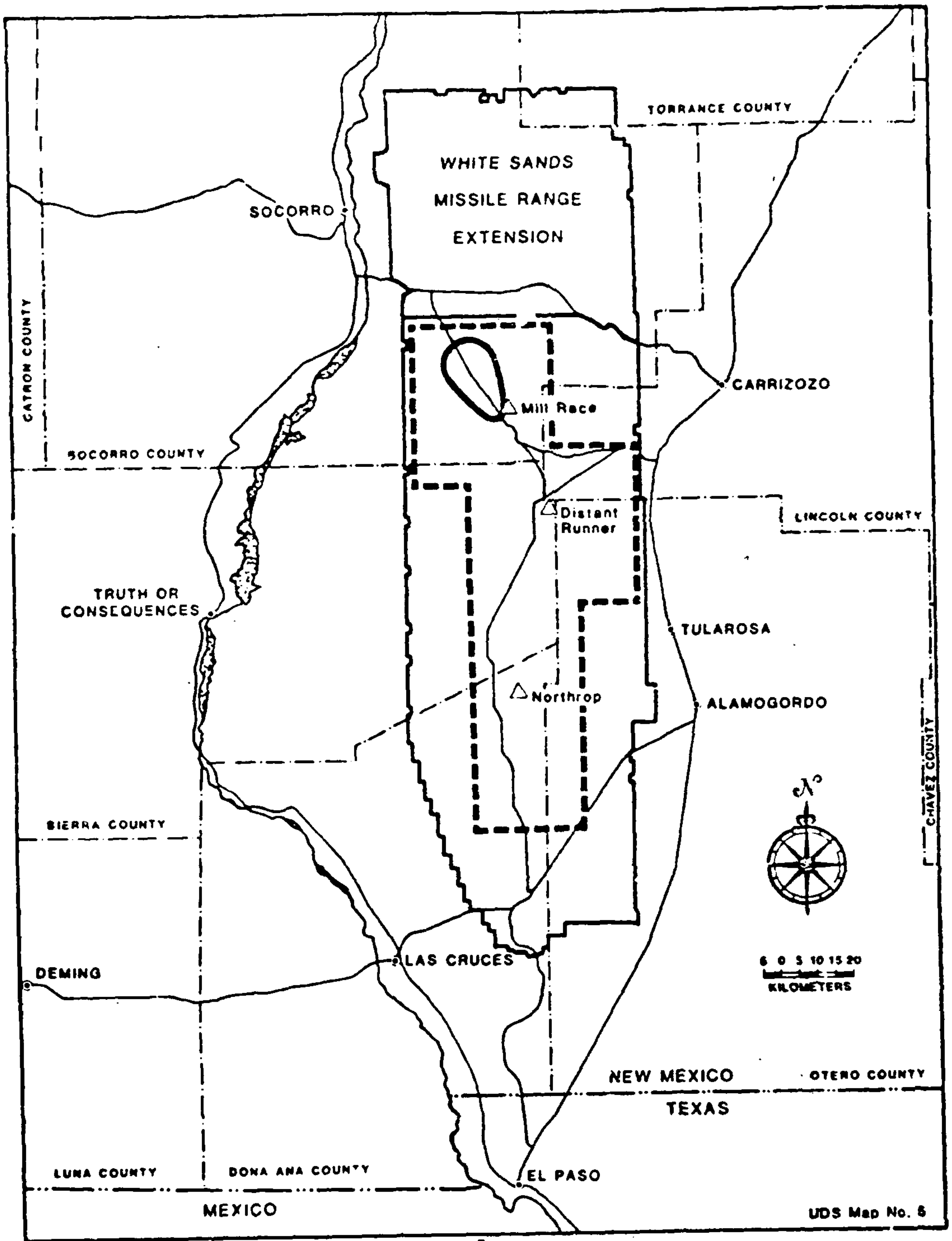
(2) Roadblocks: (See maps on pages 9 and 10).

(a) Road 5 at Stallion to SBT.

(b) Road 7 at Stallion to SBT

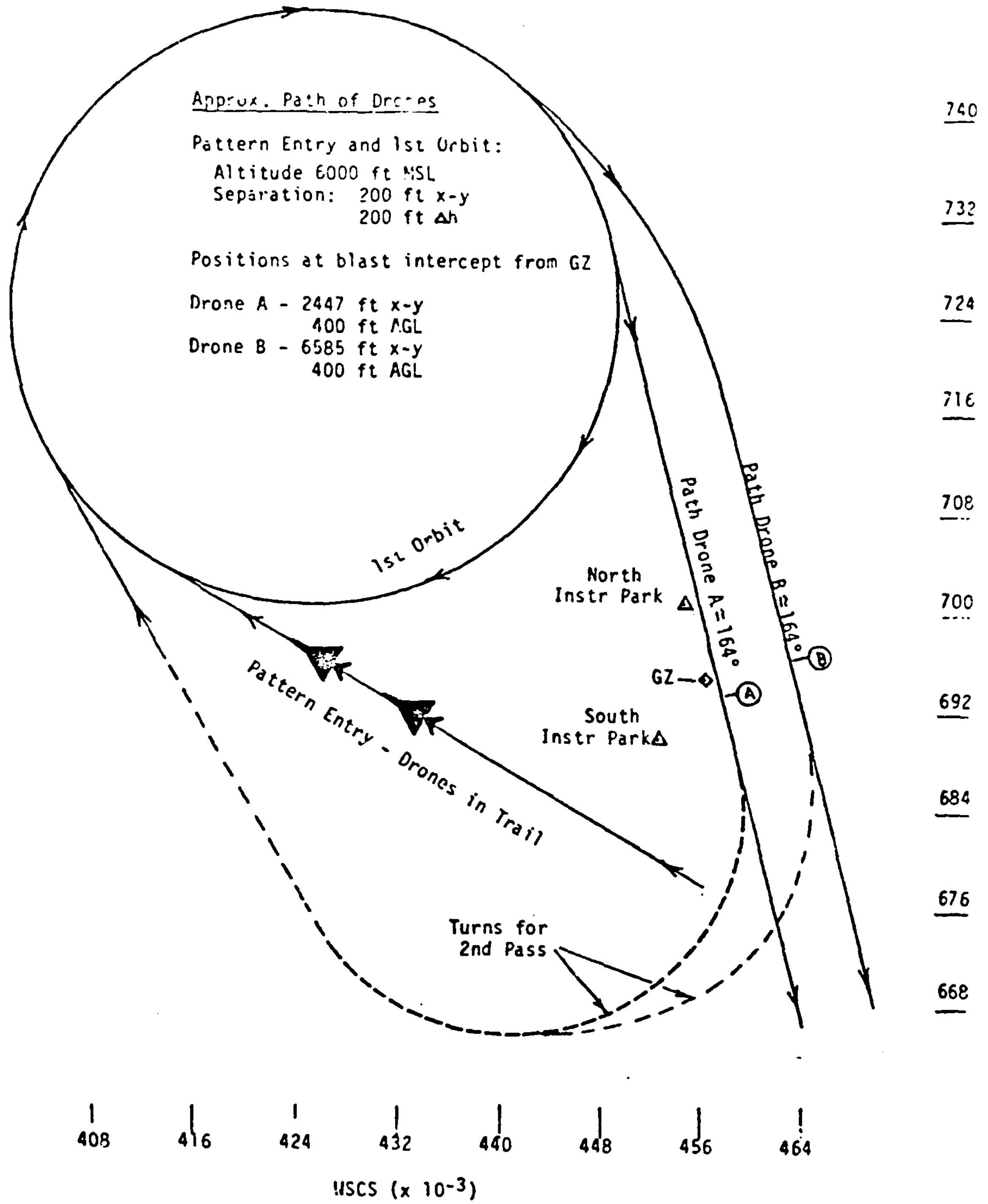
(c) Road 12 at Road 8 to WBT and SWBT.

(d) Road 9 at Road 6 to NBT.



5

Mission Profile F-86 Drones

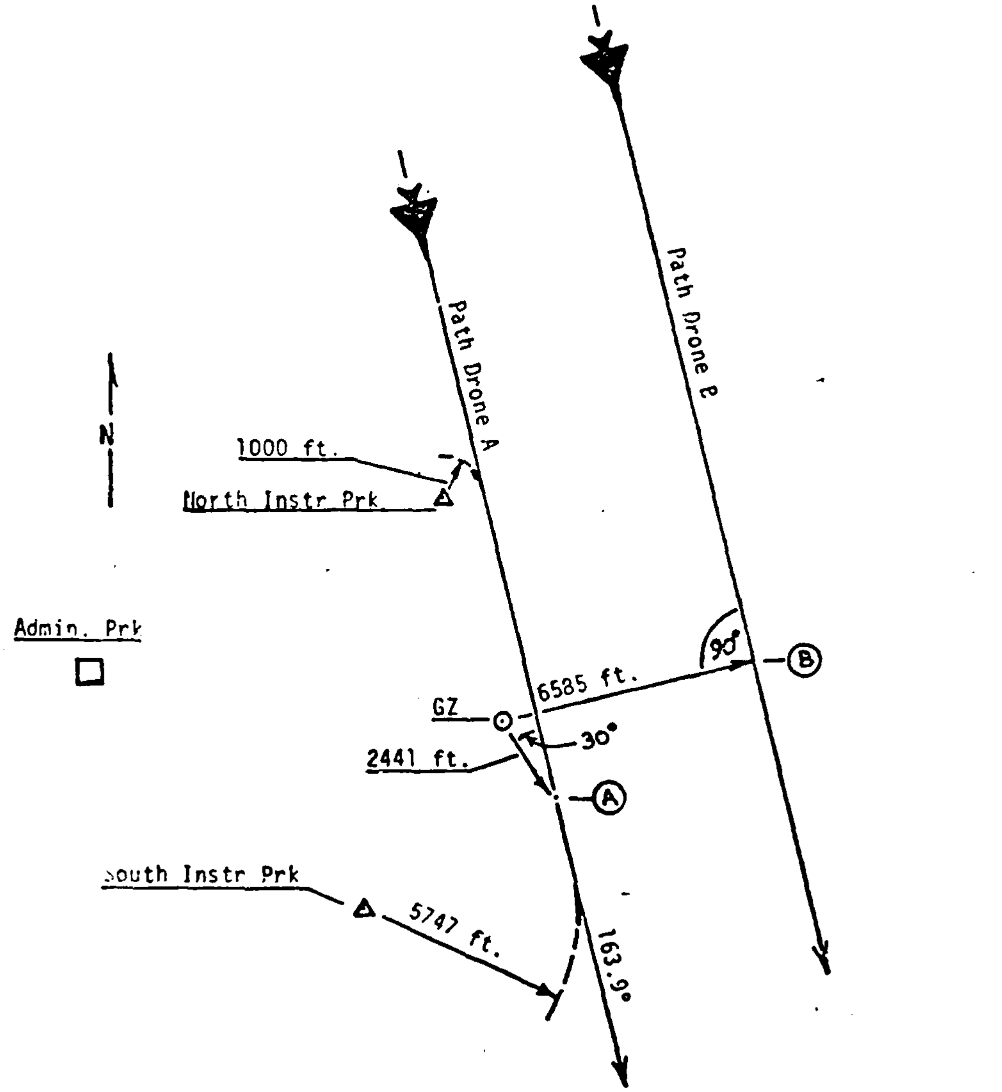


Drone flight path profile.

6

DRONE FLIGHT PATH CONTROL REQUIREMENT DURING HOT RUN

	Altitude	Heading	Distance from GZ at Blast Intercept - (A) (B)
Drone A	400 ft AGL	163.9	2441 feet
Drone B	400 ft AGL	163.9	6585 feet



Drone flight path profile.

NO: 96304A	OPERATIONS DIRECTIVE	REVISION NO:
UDS PARA		OR TEST DESIGNATOR(S): A

(e) Road 6 1.25 miles west of Road 9 to WBT.

(f) Road 10 at Road 293 to WBT.

(g) Road 7 at WANDA to NBT.

(h) Road 6 at HANFORD TO EBT.

(i) Road 5 at Road 16 to NBT and EBT.

(3) Evacuations (See Maps on Pages 9 and 10).

(a) Evacuate an area bounded by the following WSTM coordinates:

X = 495,000 Y = 700,000
X = 495,000 Y = 610,000
X = 540,000 Y = 610,000
X = 540,000 Y = 360,000

X = 500,000 Y = 360,000
X = 500,000 Y = 295,000
X = 440,000 Y = 295,000
X = 430,000 Y = 560,000
X = 375,000 Y = 560,000

X = 375,000 Y = 700,000

(b) Exceptions to evacuation

1 VIP viewing area

2 R-351, T-788, T-817, T-818, T-830, North Instrumentation Park, South Instrumentation Park and the Administrative Area.

2100 MEASUREMENTS AND DATA

a. Radar

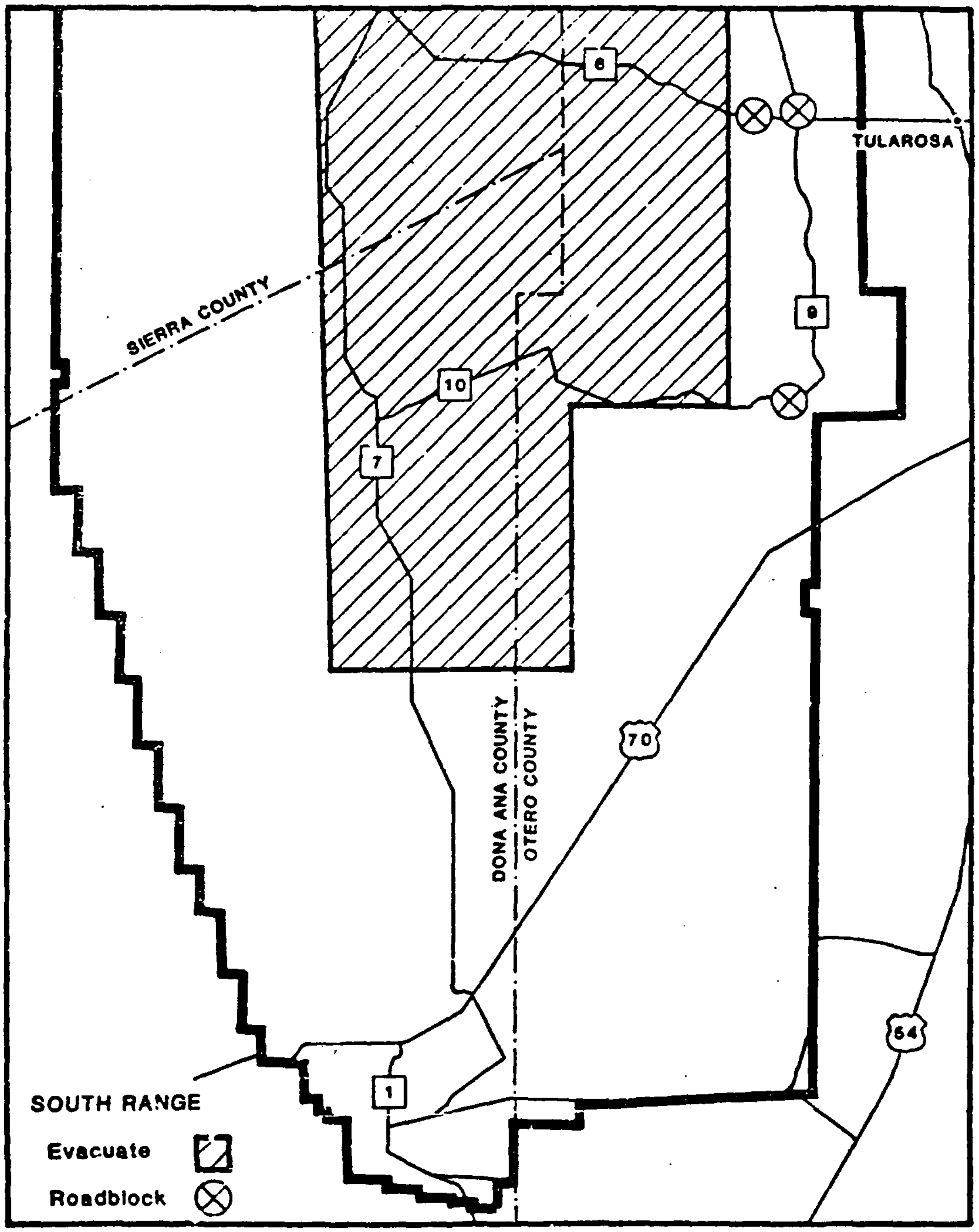
(1) Sites/Assignments: R-123 and R-127 will track QF-86A and R-122 and R-128 will track QF-86B. All radars input to King-1 plot and Bldg 300 RTDS.

(2) Support: Provide position data and provide VTCS input.

b. Telescopes

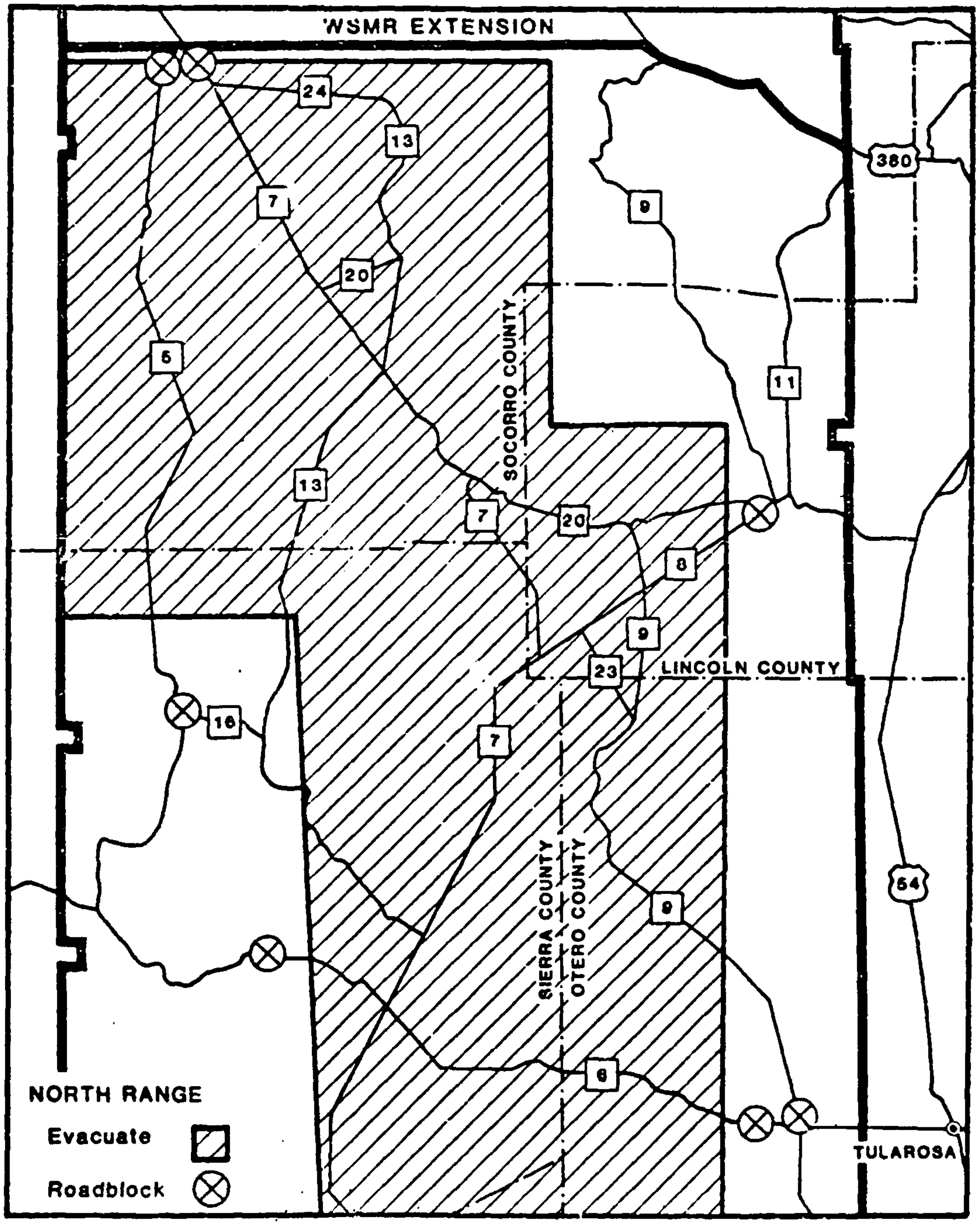
(1) Sites/Assignments: T-788, T-818, T-928 and T-929.

(2) Support: Provide event data over MILL RACE test site.



9

MILL RACE Roadblocks



10

MILL RACE Roadblocks

NO: 96304A	OPERATIONS DIRECTIVE	REVISION NO:
UDS PARA		OR TEST DESIGNATOR(S): A

c. Fixed Cameras

(1) Sites/Assignments: E-1738 and E-1739.

(2) Support: On board cameras to provide aircraft deflection.

2200 TELEMETRY MEASUREMENTS AND DATA

a. Systems/Sites: J-1, J-10, J-67, J-110, J-122 and TMV at J-1.

b. Support: Receive, record, relay and display TM data.

2300 COMMAND CONTROL/DESTRUCT

a. VTCS

(1) Sites: King-1 FGS, MGS and MTS.

(2) Support: Take off, landing and handoff to DFCS.

b. DFCS

(1) Sites: Salinas, Rose, Mule, Goat, Bldg 300, Olly, and Granjean.

(2) Support: Fly aircraft in formation racetrack over MILL RACE test site.

c. Appropriate Destruct transmitters, controlled from King-1 Plot, will be provided on a frequency of 409 MHz utilizing the following IRIG channels:

FUNCTION	QF-86A	QF-86B
ARM	1 and 5	2 and 4
DISARM	1 and 7	2 and 6
Command Destruct	5 and 7	4 and 6

2400 GROUND/AIR COMMUNICATIONS

a. Ground to air communications in the frequency range of 225.0 to 399.9 MHz will be available at the MGS, MTS, QF-86 Operations Northrup Strip, FGS, King-1, and Bldg 300 when scheduled.

b. Back up frequency should also be scheduled.

c. Recording of G/A communications will be at Bldg 300 and should be scheduled.

2700 GROUND COMMUNICATIONS

The following will be provided:

(1) A patch voice net between QF-86 Operations Northrup Strip, Range Control King-1 and Bldg 300, and DFCS.

(2) Two Class B telephones at Northrup Strip.

NO: 96304A	OPERATIONS DIRECTIVE	REVISION NO:
UDS PARA		OR TEST DESIGNATOR(S): A

(3) Existing UHF radios at Northrup Strip, MGS, FGS Console at King-1 and DFCS at Bldg 300.

(4) Circuit 36056 to provide a sync. signal from DFCS to the Fire Control Van at MILL RACE site.

2800 OTHER COMMUNICATIONS

a. IRIG B timing circuit 42279 will be provided to the DFCS.

b. Television

(1) Sites: V-0336 at T-830, V-0482 at T-818, V-0483 at T-788.

(2) Support: V-0201 relay at Atom, V-0236 receive and transmit at Alamo Peak and receive and display at King-1.

3000 REAL-TIME DATA DISPLAY AND CONTROL

a. Digital display of QF-86 altitude and velocity will be provided at King-1 and Bldg 300 OCDF.

b. X-Y and H-T position plots of the QF-86's will be provided at King-1 and Bldg 300 OCDF.

c. An event signal from the DFCS will be generated by the 1108 computer to indicate T-3.5 minutes.

3200 METEOROLOGY

a. Forecasts - Standard WSMR 24 hour (teletype) forecasts will be available. User may phone Duty Forecaster 678-1032/2605 for an updating.

b. Observations - Standard surface observations to include:

(1) Wind speed and direction
(2) Temperature (°F)
(3) Dew Point (°F)
(4) Relative humidity (%)
(5) Pressure (in/hg)
(6) Visibility (miles)
(7) Cloud coverage (%)
(8) Cloud heights (ft/AGL)
(9) Precipitation (type/amt)

will be taken at the Northrup Strip and Stallion Met Sites at T-2 hours and T-45 minutes. Data will be phoned to the Mill Race Test Director at K-1, phone 679-2704.

3300 RECOVERY

This test is assigned Recovery 3/1. Coordination telephone is 688-3313.

NO: 96304A	OPERATIONS DIRECTIVE	REVISION NO:
UDS PARA		OR TEST DESIGNATOR(S): A

3400 OTHER TECHNICAL SUPPORT

Frequency Control and Analysis

(1) Station Plan: WSMR (1), HAFB (1).

(2) Frequency Protection Plan

NOMENCLATURE OR FUNCTION	FREQ (MHz)	RFPC (±MHz)	AEB (kHz)	RFA
AN/FPS 16	As Sched	5	8,000	WS 531
AN/FPS 16	As Sched	5	18,000	WS 532
Transponder	As Sched	7.5	4.000	WS 532
A/G Commo	As Sched	0.075	6	WS 185
MGS Uplink	5800	7.5	5,400	AFC 149-A
MGS Dnlink	5880	7.5	13,000	AFC 149-A
DFCS	915	13.0	150	WS 583
TM ("A")	1515.5	7.5	5,400	AFC 149A
TM ("B")	2213.5/ 2215.5/ 2219.5	0.6	650	AFC 433
Destruct X-mitter	409	0.25	205	WS 026
Radar Altimeter	4300	NR	2500	AFC 149-B
ARM	409.475	0.04	160	

4000 COORDINATE SYSTEM DESCRIPTION

All vector parameters and components will be given relative to WSCS. For the special pitch measurements, pitch is defined as the angle between a plane normal to the WSCS 500k/500k gravity vector and a line through the longitudinal axis of the aircraft (fore and aft extreme points).

4200 DATA DELIVERY AND DISPOSITION

a. Drone command and control TM data and trajectory plots:

Flight Systems, Inc.
P. O. Box 903 Bldg 1082
Holloman AFB, NM 88330

b. Data tapes from WSMR TM stations:

6585th TG-TKO
ATTN: Mr. Thomas R. Bruce
Holloman AFB, NM 88330

OD NO: 96304A UDS PARAGRAPH 2000	MASTER COUNTDOWN & OPERATION LOG	REVISION NO: OR TEST DESIGNATOR(S): A	PRIORITY: 3	SERVICE: O	PAGE 1 OF 7
			OPN TITLE: Dual Manned QF-86F Drone Flyby		
OPN INDEX:	TEST DATE:	RANGE CONTROLLER:			

EVENT NO	RESP ELEM	EVENT	T+TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
		STARTS TEST					
1	NR-CR	Mans Range Control Complex.	-06H 00M				
2	NR-CF	Installs FTS on both QF-86's.	-05H 30M				
3	NR-CF	Completes installation of FTS.	-05H 00M				
4	NR-CF	Starts FTS system checks - QF-86 A.	-05H 00M				
5	NR-CF	Completes FTS system checks - QF-86 A.	-04H 10M				
6	NR-CF	Starts FTS system checks - QF-86 B.	-04H 10M				
7	NR-CR	Begins communications check.	-04H 00M				
8	NR-CR	Requests 409MHz clearance.	-03H 25M				
9	NR-D	Radars avoid Northrup Strip.	-03H 25M				
10	NR-CF	Completes FTS system checks - QF-86 B.	-03H 20M				
11	NR-CR	Verifies 409MHz clearance.	-03H 20M				
12	NR-CR	Verifies radar avoidance.	-03H 20M				
13	NR-CE	Loads QF-86B FTS ordnance	-03H 20M				
14	NR-CE	Completes loading QF-86 FTS ordnance.	-02H 45M				
15	NR-CE	Loads QF-86 A FTS ordnance.	-02H 45M				

STEWS-NR-P Form 25(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

OD NO: 96304A

UDS PARAGRAPH 2000

MASTER COUNTDOWN & OPERATION LOG (Continuation)

REVISION NO:

OR TEST DESIGNATOR(S): A

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
16	NR-CE	Completes loading QF-86 A FTS ordnance	-02H 00M				
17	NR-CR	Terminates 409MHz clearance.	-02H 00M				
18	NR-D	Lifts radar avoidance of Northrup Strip.	-02H 00M				
19	NR-CR-C	Starts DFCS pre-start checks QF-86 B.	-01H 55M				
20	NR-CR-C	Arrives at the OCDF and King 1 plotting facility.	-01H 30M				
21	NR-CR-C	Provides grids to the OCDF and King 1 plotting facility.	-01H 30M				
22	NR-CR-C	Completes DFCS pre-start checks on QF-86 B.	-01H 20M				
23	NR-CR-C	Starts DFCS pre start checks. QF-86A.	-01H 20M				
24	NR-CR	Resumes communications check, contacts DFCS and OCDF target coordinators on range command net, provides time check and checks ready-hold system.	-01H 00M				
25	NR-CR	Starts RTDS.	-01H 00M				
26	NR-CR	Starts radar static words.	-01H 00M				
27	NR-CR	Starts telemetry static points.	-01H 00M				
28	NR-CR	Starts optics static points.	-01H 00M				

STEWS-NR-P Form 25-1(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10.

OD NO: 963044 | UDS PARAGRAPH 2000

MASTER COUNTDOWN & OPERATION LOG
(Continuation)

REVISION NO: OR TEST DESIGNATOR(S): A

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
29	NR-CR	Completes radar static words.	-55M 00S				
30	NR-CR	Starts radar slews.	-55M 00S				
31	NR-CR	Directs SO-P to set Northrup Strip roadblocks.	-55M 00S				
32	NR-CR	Verifies Northrup roadblocks set.	-50M 00S				
33	NR-CR	Obtains status report for QF-86 engine start from:	-50M 00S				
a.	NR-A	Computer					
b.	TWS	Communications					
c.	NR-O	Optics					
d.	NR-CF	Missile Flight Safety Officer					
e.	User	Test Conductor					
f.	NR-D	Radar					
g.	NR-D	Telemetry					
34	NR-CR	Announces status of range (for QF-86 engine start).	-47M 00S				
		RANGE READY					
35	NR-CR-C	Completes DFCS pre start checks on QF-86A.	-45M 00S				
36	NR-CR	Completes optics static points.	-45M 00S				
37	NR-CR	Completes telemetry static points.	-45M 00S				
38	NR-CR	Completes radar slews.	-45M 00S				
39	NR-CR	Starts radar static points.	-45M 00S				

STEWS-NR-P Form 25-1(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

OD NO: 96304A

UDS PARAGRAPH 2000

MASTER COUNTDOWN & OPERATION LOG
(Continuation)

REVISION NO:

OR TEST DESIGNATOR(S): A

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
40	NR-CR-C	Starts QF-86 B engine.	-45M 00S				
41	NR-CR-C	Starts QF-86 A engine.	-42M 00S				
42	NR-CE	Arms FTS.	-40M 00S				
43	NR-CR	Completes radar static points.	-35M 00S				
44	NR-CR	Loads operational program.	-35M 00S				
45	NR-CE	Completes arming FTS.	-30M 00S				
46	RUM	Advices NR-CR when chase aircraft are airborne.	-30M 00S				
47	NR-CR	Provides count to MILL RACE Detonation.	-30M 00S to -00M 00S				
48	NR-D	Starts QF-86 B telemetry recordings.	-25M 30S				
49	NR-CR-C	Takes off QF-86 B from Northrup Strip under control of MGS.	-25M 00S				
50	NR-D	Starts QF-86 B radar recording.	-25M 00S				

STEWS-NR-P Form 25-1(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

OD NO: 96304A

UDS PARAGRAPH 2000

MASTER COUNTDOWN & OPERATION LOG (Continuation)

REVISION NO: OR TEST DESIGNATOR(S): A

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
51	NR-CR-C	Transfers QF-86 B control to FGS/DFCS.	-22M 00S				
52	NR-D	Starts QF-86 radar recording.	-20M 00S				
53	NR-D	Starts QF-86 telemetry recording.	-20M 30S				
54	NR-CR-C	Takes off QF-86 A from Northrup Strip under control of MGS.	-20M 00S				
55	NR-CR-C	Transfers QF-86 A control to FGS/DFCS.	-17M 00S				
56	RUM	Advises NR-CR when chase aircraft is airborne.	-15M 00S				
57	NR-CR-C	QF-86A crosses first synchronization point.	-08M 30S				
58	NR-CR-C	QF-86A crosses final synchronization point.	-03M 30S				
59	NR-CR-C	Initiates signal for circuit closure at MILL RACE Fire Control Van.	-03M 30S				
60	NR-CR-C	Turns airborne optics ON.	-00M 30S				
61	NR-D	Turns ground optics ON.	-00M 30S				
62	User	Starts MILL RACE detonation.	-00M 00S				
63	NR-CR-C	Turns airborne optics OFF.	+00M 10S				
64	NR-D	Turns ground optics OFF.	+00M 30S				

STEWS-NR-P Form 25-1(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

OD NO: 96304A

UDS PARAGRAPH 2000

MASTER COUNTDOWN & OPERATION LOG (Continuation)

REVISION NO: OR TEST DESIGNATOR(S): A

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
65	NR-CR-C	Transfers control of QF-86s from DFCS to FGS/MGS.	+ M S				
66	NR-CR-C	Lands QF-86s at Northrup Strip.	+ M S				
67	NR-D	Completes QF-86 radar recording.	Upon Landing				
68	NR-D	Completes QF-86 telemetry recording.	Upon Landing				
69	NR-CR	Lifts Northrup Strip roadblocks.	When area is clear				
70	NR-CR	Requests 409 MHz clearance.	+ M S				
71	NR-D	Radars avoid Northrup Strip.	+ M S				
72	NR-CR	Verifies 409 MHz clearance.	+ M S				
73	NR-CR	Verifies radar avoidance.	+ M S				
74	NR-CE	Starts FTS disarming and downloading of ordnance.	+ M S				
75	NR-CE	Completes FTS disarming and down-loading of ordnance.	+ M S				
76	NR-D	Lifts radar avoidance of Northrup Strip.	+ M S				
77	NR-CR	Terminates 409 MHz clearance.	+ M S				

STEWS-NR-P Form 25-1(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

OD NO: 96304A	MASTER COUNTDOWN & OPERATION LOG (Continuation)	REVISION NO:	PAGE 7 OF 7
UDS PARAGRAPH 2000		OR TEST DESIGNATOR(S): A	

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
78	NR-CR-C	Starts final post flight checks with MGS.	+ M S				
79	NR-CR-C	Completes final post flight checks with MGS.	+ M S				
80	NR-CR	Terminates operation. Releases supporting elements.	End of Range Time				
		TEST COMPLETED					

STEWS-NR-P Form 25-1(Rev) Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c
1 Aug 78

OD NO: 96304A	DATA PROCESSING CAPABILITY ESTIMATE	REVISION NO:	OBJECT: QF-86E (2 Targets)	PAGE 1 OF 1
MDS PARAGRAPH 4100		OR TEST DESIGNATOR(S): A	OBJECT REFERENCE: CG	

DATA ITEM		DATA COLLECTION			DATA PROCESSING						
LINE NO	PARAMETER	PERIOD OR SEGMENT	DATA SOURCE	SAMPLE RATE	DATA RATE	1-SIGMA ERROR EST & UNITS	REP/ COORD	MEDIUM & COPIES	SEC CLASS	DATA TYPE & DEL TIME	TEL AGENCY
1	Position	T-30 sec T+30 sec	Radar		1/sec	+5m	SSCS	Listing 3	U	5WD	NR-A
2	Velocity	"	"		"	+8m/sec	"	"	"	"	"
3	Ground Speed	"	"		"	+8m/sec	"	"	"	"	"
4	PHI	"	"		"	+3 deg	"	"	"	"	"
5	HAT	"	"		"	+3m	"	"	"	"	"
6	Position	T-30 sec T+30 sec	DFCS		1/sec	+5m	SSCS	Listing 3	U	5WD	NR-A
7	Velocity	"	"		"	+3m/sec	"	"	"	"	"
8	Ground Speed	"	"		"	+8m/sec	"	"	"	"	"
9	PHI	"	"		"	+3 deg	"	"	"	"	"

REMARKS:

*Project requires best available data from Vega control radars and DFCS data sources.

Time to be measured from T-0.

Data to be furnished separately for each of two QF-86E target drones.

STEWS-NR-P Form 5(Rev)
1 Aug 78

Replaces STEWS-NR-P Form 6, 1 Apr 74, which is obsolete.

STEWS-NR-P SOP 70-10c

APPENDIX B-4

OPERATIONS DIRECTIVE No. 9 6 3 0 8 A

MILL RACE

(PROGRAM SHORT TITLE)

OD NO. 9 6 3 0 8 A

OR TEST DESIGNATOR(S)	TEST TITLE
A	B-52 Fly Over

The support plan in this OD is based on the capability of the Range to provide support indicated, subject to availability when scheduled.

D L Meadows
NR Project Engineer

678-1622
Telephone No.

FOR THE COMMANDER:

BART A. GOODE
Technical Director, NR

29 July, 1981
DATE

THIS DOCUMENT IS CANCELLED WHEN NOT SCHEDULED WITHIN A TWO-YEAR PERIOD

WHITE SANDS MISSILE RANGE
NEW MEXICO

EYC

OD NO: 96303 A	DISTRIBUTION	REVISION NO:
PARAGRAPH 1020		OR TEST DESIGNATOR(S): A

AA.	1
AFC	0
ATZC-MDMC-SE	1
CCNC-TWS.	10
DELAS-DP	2
FE-ER	1
LG-R	3
NR-AO	5
NR-CF	1
NR-CR	6
NR-D	8
NR-CS	2
NR-CS-DMA	1
NR-PD	6
NR-PR	1
NR-CU	0
PL	0
QA	1
DP-F.	1
DP-S.	1

AIR FORCE

AD-RUC.	1
Cdr, 6585 Test Gp, ATTN: AD-RUM, Holloman AFB, NM 88330.	1
Cdr, 6585 Test Gp, ATTN: ATO, Holloman AFB, NM 88330.	0
Cdr, Armt Div ATTN: AD-TEPA, Eglin AFB, FL 32542	0
Field Command, DNA ATTN: FCTOH Kirtland AFB, NM 87115	10
TE	0
NOMTF	0

Pages 293-297 deleted

APPENDIX B-5

OPERATIONS DIRECTIVE No. 9 7 9 1 6 A

SANDIA TESTS

(PROGRAM SHORT TITLE)

OD NO. 9 7 9 1 6 A

OR TEST DESIGNATOR(S)	TEST TITLE
A	Altitude Pressure Measurements (APM) - Mill Race

The support plan in this OD is based on the capability of the Range to provide support indicated, subject to availability when scheduled.

Robert G. Wright
NR Project Engineer

678-2786
Telephone No.

FOR THE COMMANDER:

BART A. GOODE
Technical Director, NR

4 August 1981
DATE

THIS DOCUMENT IS CANCELLED WHEN NOT SCHEDULED WITHIN A TWO-YEAR PERIOD

WHITE SANDS MISSILE RANGE
NEW MEXICO

RMN

OD NO: 97916A	DISTRIBUTION	REVISION NO:
PARAGRAPH 1020		OR TEST DESIGNATOR(S): A

AA. 1

AFC 0

ATZC-MDMC-SE 1

CCNC-TWS. 10

DELAS-DP 2

FE-ER 1

LG-R 3

NR-AO 5

NR-CF 1

NR-CR 6

NR-CU 0

NR-D 8

NR-CS 2

NR-CS-DMA 1

NR-PA 1

NR-PR 1

PL 0

QA 1

DP-F. 1

DP-S. 1

AIR FORCE

AD-RUC. 1

Cdr, 6585 Test Gp, ATTN: AD-RUM,
Holloman AFB, NM 88330. 1

Cdr, 6585 Test Gp, ATTN: ATO,
Holloman AFB, NM 88330. 0

Cdr, Armt Div
ATTN: AD-TEPA, Eglin AFB,
FL 32542 0

TE-LG 15

TE-PY 1

TE-PS 1

NOMTF 0

NO: 97916A	OPERATIONS DIRECTIVE	REVISION NO: OR TEST DESIGNATOR(S): A
UDS PARA		

1100 PROGRAM AND TEST INFORMATION

a. Program Information

(1) User: Sandia Laboratories, Albuquerque, New Mexico.

(2) Sponsor: ARMTE.

(3) Program Priority: 3.

b. Test Information

(1) Test Conductor: Doug Agee, ARMTE, 678-2919/3919.

(2) ARMTE Project Engineer: Howard Huddleston, 678-5901.

(3) User Control Point: Project Control Console Bldg 300.

(4) Range Control Point: Console 8 or 9, 678-2221, (Bldg 300).

(5) OR TEST DESIGNATOR/OD COMPARISON:

TEST DESIGNATOR(S)	OD	TEST TITLE
A	97916A	Altitude Pressure Measurements (APM) - Mill Race
XA	97916XA	APM Dress Rehearsal

(6) Test Description: Four telemetry equipped, parachute retarded, canisters will be dropped from an A-7 aircraft over the MILL RACE EVENT. The A-7 will fly a heading of 10°T at 360 KTAS at an altitude of 35,000 ft MSL. The first canister will be released at T-01m 30 sec and subsequent canisters will be dropped at 30 sec intervals with the last canister to be released at T-0 in the MILL RACE countdown. Two practice runs for vectoring the aircraft will be conducted prior to the hot run. Each canister is a modified flare canister, 5 inches in diameter, 36 inches long painted flame orange weighing 22 lbs with a 16 ft diameter white parachute. The illuminant and ignition components have been removed and replaced with instrumentation. The parachute timer will deploy the parachute 6 sec after release which will initiate TM equipment turn on. The first canister is to be released at minus 1.5 minutes so that it is closest to being over ground zero when the shock wave reaches it approximately 30 seconds after shot time. The other three canisters will be released at 30 second intervals on the flight course of 10° true. The last canister will be released at T-0 in the MILL RACE countdown. The no-wind range is 2700 feet and the effect of a one knot wind during the time before shock arrival is 250 feet. Total time of fall is 26 minutes.

The zone wind effects for the entire trajectory are as follows:

Zone (K ft)	Recarded (ft/knot)	Free Fall (ft/knot)
30-35	360	27
25-30	390	30
20-25	420	33
15-20	460	36
10-15	500	40
5-10	560	45

NO: 979166	OPERATIONS DIRECTIVE	REVISION NO:
UDS PARA		OR TEST DESIGNATOR(S): A

The no-wind free fall range of a unit will be 5800 ft if the chute fails to open and will have a time of fail of 2 min 4 sec.

(7) Security classification: No classified information or data will result from this test.

UDS PARA	LIMITATION
1400	Records do not show authority to use the following frequencies on WSMR: TM frequencies 2210.5, 2226.5, 2232.5, 2240.5 MHz and VHF frequencies 167.85 and 168.45 MHZ. The project must obtain authorization before these frequencies can be scheduled. (TWS).

1700 TEST ENVELOPE INFORMATION

a. Test Limits

(1) Aircraft

(a) Release altitude: 10667m (35,000 ft)

(b) Speed: 360 KTAS $\pm$50k

(c) Heading: 10°T

(2) Drop Limits

(a) The A-7 which wi drop the canisters must be positioned such that at the point of each release no part of an unretarded (parachute fails to open) 3-sigma impact prediction area comes closer than one nautical mile to any manned site, or any evacuation area boundary. If the aircraft cannot be positioned, the drops will not be allowed to occur. Further, no drops will be allowed to occur if any part of a 3-sigma retarded impact prediction area ellipse exceeds WSMR boundaries.

b. Operating Limits. Impact prediction data for both retarded and unretarded drop conditions must be made using the most current meteorologic data available.

c. Airspace Operations

See STEWS-NR-P Form 46-e airspace map for airspace operations, page 4.

1800 OPERATIONAL HAZARDS

Ground Safety

SOP NR-CS 47-80 is applicable to recovery operations.

NO: 97916A	OPERATIONS DIRECTIVE	REVISION NO: OR TEST DESIGNATOR(S): A
UDS PARA		

2000 TEST OPERATIONAL CONCEPTS/SUMMARIES

a. Test Events

EVENT NO	±TIME	EVENT
1	-7WD	User submits DA Form 3903 to NR-DK for documentary photography.
2	-7WD	User submits schedule to NR-CR.
3	-3WD	User briefs NR-CS.
4	-1WD	User briefs Major Coordinate Elements.
5	-2H 30M	WSMR starts master countdown (MCD). See MCD beginning on page A-1.
6	+ASAP	User provides NR-CF impact data on test unit.
7	+ASAP	User provides NR project engineer, 678-2786, deviations to post-test support.
8	+ASAP	NR project engineer submits Post-Test Counterorder (PTC) to WSMR support elements for post-test support deviations.

b. Flight Safety Operational Concepts/Summaries

(1) Termination Method: NA.

(2) Roadblocks and Evacuations: See MFSOP for OD 96304A.

2100 MEASUREMENTS AND DATA

a. Radar

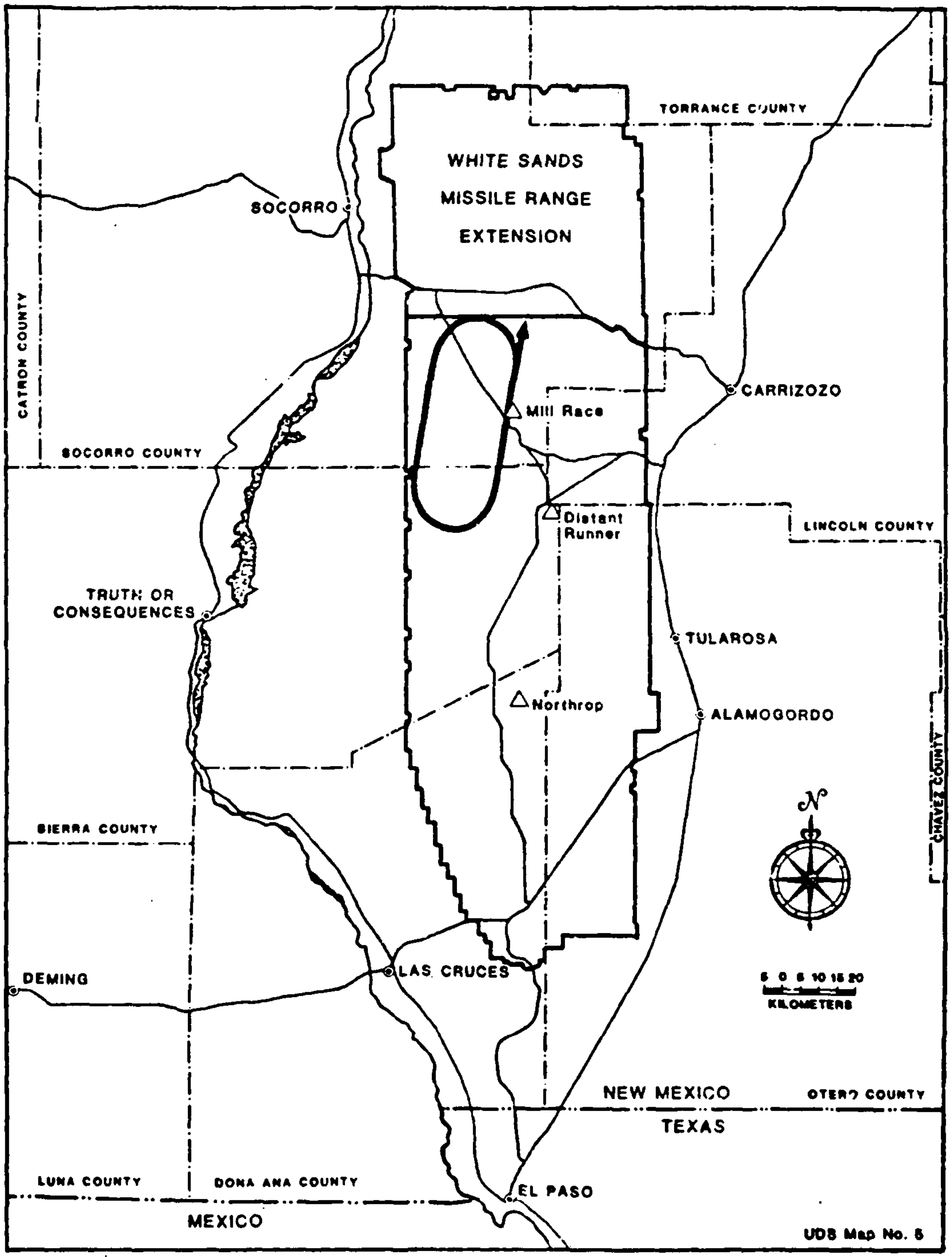
(1) Sites/Assignments:

A-7: R-351
Canister 1: R-124
Canister 4: R-125

(2) Support: Transponder Track A-7, record DIGS. Input to Building 300; skin track canisters to impact, record DIGS/AGC, input to Building 300.

(3) Data Priority: 1A

(4) Safety Priority: 1A. One radar required for A-7 track and one radar to track first and fourth canister for impact prediction.



4

Mission Profile, A7

b. AME

(1) Sites: Cube and Laura.

(2) Support: Track canister #2 & #3, record data for post flight, input Bldg 300.

(3) Data Priority: 1A.

2200 TELEMETRY MEASUREMENTS AND DATA

a. Sites: RF #1: J-10, RF #2 & 3: J-110, RF #4: J-138.

b. Support: Track and relay RF-2, 3 & 4 to J-10. Track RF-1, receive RF-2, 3 & 4, record all RFs.

c. Data Priority: 1A.

2400 AIR/GROUND VOICE COMMUNICATIONS

Air/ground radio communications in the frequency range of 225.0 to 399.9 will be available to the vectoring personnel at the OCDF. The user must schedule all frequencies required.

3000 REAL-TIME DATA DISPLAY AND CONTROL

a. Plotting boards at the OCDF will be provided as follows:

NO	TYPE	GRID	PLOT
1	X vs Y H vs Y	1000 yd/in 4000-35000 MSL	A-7 A-7
1	X vs Y H vs R	1000 yd/in 4000-35000 MSL	Units #1 & 4 (radar) Units #1 & 4 (radar)
1	X vs Y H vs R	1000 yd/in 4000-35000 MSL	Units #2 & 3 (AME) Units #2 & 3 (AME)

NO: 97916A	OPERATIONS DIRECTIVE	REVISION NO: OR TEST DESIGNATOR(S): A
UDS PARA		

b. Digital displays as follows:

NO	TYPE	DISPLAY	UNITS
1	Velocity	A-7	Ft/sec
1	Altitude	A-7	Ft
4	Altitude	All units	Ft
4	Velocity	All units	Ft/sec
4	Velocity Vector Az	All units	Deg

3100 PHOTOGRAPHY

Documentary photographic support will be provided as requested on a photographic work order, DA Form 3903, submitted to NR-DK, Bldg 1621, 5 workdays prior to need.

3200 METEOROLOGY

a. Forecasts. Standard WSMR 24 hour (teletype) forecasts will be available.

b. Observations. Upper air observational data will be provided from rawinsonde balloon observation releases as follows:

SITE	TIME
MINE	T-4 hours
AFSWC	T-3 hours
MINE	T-2 hours
AFSWC	T-0 hours

Data will be collected from surface to 45K ft MSL. The T-4, T-3, and T-2 hour releases will be reduced in the following layers and data will be phoned to Test Conductor 678-2676/2817/2017 ASAP.

Surface to 10K ft MSL
10K ft to 15K ft MSL
15K ft to 20K ft MSL
20K ft to 25K ft MSL
25K ft to 30K ft MSL
30K ft to 35K ft MSL

Also direction and speed at 35K ft MSL.

NO: 97916A	OPERATIONS DIRECTIVE	REVISION NO: OR TEST DESIGNATOR(S): A
UDS PARA		

3300 RECOVERY

a. Classification: Class 3.

b. Disposition. All debris will be recovered by the user.

3400 OTHER TECHNICAL SUPPORT

Frequency Control and Analysis

(1) Station Plan: WSMR (1), Albuquerque (1)

(2) Frequency Protection Plan. All usage of the following frequencies must be scheduled with the Range Scheduling Committee.

NOMENCLATURE OR FUNCTION	FREQ MHz	RFPC ±MHz	AEB kHz	RFPC (±MHz)
Range Radar	As Sched	WS 531	8000	5
" "	As Sched	WS 532	18000	5
Transponder	"	WS 532	4000	7.5
A/G Comm	"	WS/185/ ADTC 66-77	6	0.075
Project Comm	*			
Telemetry	*			

*See Para 1100 for limitation.

4000 COORDINATE SYSTEM DESCRIPTIONS

The WSCS right hand cartesian coordinate system will be used with MILL RACE Ground Zero as the origin. The Y-axis will be directed through the longitude or heading of the drop aircraft (10°) positive North and X axis will be positive east of the flight path.

The WSTM coordinates for MILL RACE Ground Zero are:

X = 455,986.68
Y = 629,209.61
H = 4,912.56

NO: 97916A	OPERATIONS DIRECTIVE	REVISION NO: OR TEST DESIGNATOR(S): A
UDS PARA		

4200 DATA DELIVERY AND DISPOSITION

a. Disposition: Real-time and raw data which is available on the test day will be delivered to the test team. Data not delivered on the test day will be delivered to Mr. Robert Pace, Bldg 1690, WSMR, 678-1248/1249.

b. Real-Time and Raw Data

ITEM	DATA DESCRIPTION	MEDIA/COPIES	DELIVERY/MAILING TIME
1	A-7 Position	PLOTTING Bds/1	1 hour
2	Drop Unit Position (Radar)	Plotting Bd/ 1 Per Unit	1 hour
3	Drop Unit Position (AME)	Plotting Bds/ 1 Per Unit (2)	1 hour
4	Meteorological Wind Speed & Direction	Phone Call	ASAP
5	TM Oscillograms	Strip Charts/1	2 hours
6	TM Mag Tape	Tape/1	2 hours

c. Final Data

ITEM	DATA DESCRIPTION	MEDIA/COPIES	DELIVERY/MAILING TIME
1	Position Data A-7 & Drop Units (Radar)	Listings/1	20 workdays
	Position Data Drop Unit (AME)	Listing/1	20 workdays
	Meterological Wind Speed & Direction	Listing/3	7 workdays

OD NO: 97916A	MASTER COUNTDOWN & OPERATION LOG	REVISION NO:	PRIORITY:	SERVICE:	PAGE 1 OF 4
UDS PARAGRAPH 2000		OR TEST DESIGNATOR(S): A	OPN TITLE: Altitude Pressure Measurements (APM MILL RACE - Sandia Tests		

OPN INDEX: TEST DATE: RANGE CONTROLLER:

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
		STARTS TEST					
1	NR-CR	Mans Range Control Complex.	-02H 30M				
2	NR-D	Starts aircraft transponder check.	-02H 00M				
3	NR-D	Arrives at the OCDF.	-01H 45M				
4	User	Provides grids to the OCDF.	-01H 45M				
5	NR-D	Completes aircraft transponder check.	-01H 30M				
6	NR-CR	Conducts communications check. Range Controller contacts the coordinator on range command net. NR-CR provides time check and checks ready-hold system.	-01H 00M				
7	NR-CR	Starts RTDS.	[illegible] 00M				
8	NR-CR	Starts radar static words.	[illegible]H 00M				
9	NR-CR	Starts optics static points.	-01H 00M				
10	NR-CR	Starts telemetry static words.	-01H 00M				
11	NR-CR	Starts AME static points.	-01H 00M				
12	NR-CR	Completes radar static words.	-55M 00S				
13	NR-CR	Starts radar slews	-55M 00S				
14	NR-CR	Completes radar slews.	-50M 00S				

STEWS-NR-P Form 25(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

OD NO: 97916A

UDS PARAGRAPH 2000

MASTER COUNTDOWN & OPERATION LOG
(Continuation)

REVISION NO: OR TEST DESIGNATOR(S) A

PAGE 2 OF 6

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
15	NR-CR	Starts radar static points.	-50M 00S				
16	NR-CR	Completes radar static points.	-45M 00S				
17	NR-CR	Completes optics static points.	-45M 00S				Note: 4 canisters will be released at 30 sec intervals starting at T-01M 30S.
18	NR-CR	Completes telemetry static words.	-45M 00S				
19	NR-CR	Completes AME static points.	-45M 00S				
20	RUM	Takes off (aircraft) from KAFB. Advises NR-CR when aircraft is airborne.	-45M 00S				
21	NR-CR	Loads operational program.	-30M 00S				
22	NR-CR	Vectors aircraft.	-30M 00S				
23	NR-CR	Obtains status report from:	-07M 00S				
a.	TWS	Communications					
b.	NR-D	Telemetry					
c.	NR-D	Radar					
d.	NR-D	AME					
e.	NR-CF	Flight Safety					
f.	NR-A	RTDS					
g.	NR-C	DFCS					
h.	User	Test Conductor					
24	NR-CR	Announces status of range. HOLDS IF RED.	-04M 00S				
		RANGE READY					
25	NR-D	Starts canister radar recording. (Hot run only)	-03M 00S				

STEWS-NR-P Form 25-1(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

OD NO: 97916A	MASTER COUNTDOWN & OPERATION LOG (Continuation)	REVISION NO:	PAGE 3 OF 6
UDS PARAGRAPH 2000		OR TEST DESIGNATOR(S):	

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
26	NR-D	Starts aircraft radar recording.	-02M 00S				
27	NR-CR	Counts in 5S increments to canister release.	-02M 00S				
28	NR-CR	Counts in 1S increments.	-01M 40S				Note: Two dry runs will be conducted prior to the first canister release.
29	User	Releases canister #1 or simulates release.	01M 30S				
30	NR-CR	Counts in 5S increments to canister release.	-01M 25S				
31	NR-D	Starts telemetry recording.	01M 24S				
32	NR-CR	Counts in 1S increments.	01M 10S				
33	User	Releases canister #2.	01M 00S				
34	NR-CR	Counts in 5S increments to canister drop.	00M 55S				
35	NR-D	Starts telemetry recording.	-00M 54S				Notes: AME will track canisters 2 and 3.
36	NR-D	Starts AME track and record (Unit 2).	-00M 54S				
37	NR-CR	Counts in 1S increments.	-00M 40S				
38	User	Releases canister #3.	-00M 30S				
39	NR-CR	Counts in 5S increments to canister drop.	-00M 25S				

OD NO: 97916A

UDS PARAGRAPH 2000

MASTER COUNTDOWN & OPERATION LOG (Continuation)

REVISION NO:
OR TEST DESIGNATOR(S):

EVENT NO	RESP ELEM	EVENT	T±TIME	ACTUAL TIME	STATUS G	STATUS R	REMARKS
40	NR-D	Starts telemetry recording.	-00M 24S				
41	NR-D	Starts AME track and record (Unit 3).	-00M 24S				
42	NR-CR	Counts in 1S increments.	-00M 10S				
43	User	Releases canister #4 (MILL RACE EVENT T-0).	-00M 00S				
44	NR-D	Starts telemetry recording.	+00M 06S				
45	NR-D	Completes canister radar recording.	Impact				
46	NR-D	Completes AME track and record.	LOS				
47	NR-D	Provides NR-CR impact information.	After Impact				
48	NR-CR	Releases aircraft to Cherokee.	+ M S				
49	NR-D	Completes telemetry recording.	LOS				
50	NR-D	Completes aircraft radar recording.	+ M S				
51	NR-CR	Terminates operation; releases supporting elements.	End of Range Time				
		TEST COMPLETE					

STEWS-NR-P Form 25-1(Rev) 1 Aug 78 Replaces STEWS-NR-P Form 25-1, 1 Jul 73, which is obsolete. STEWS-NR-P SOP 70-10c

CD NO: 97916A TDS PARAGRAPH 4100	DATA PROCESSING CAPABILITY ESTIMATE	REVISION NO: OR TEST DESIGNATOR(S): A	OBJECT: A7 and Drop Units OBJECT REFERENCE: N/A	PAGE 1 OF 2

DATA ITEM		DATA COLLECTION			DATA PROCESSING						
LINE NO	PARAMETER	PERIOD OR SEGMENT	DATA SOURCE	SAMPLE RATE	DATA RATE	1-SIGMA ERROR EST & UNITS	REF/ COORD	MEDIUM & COPIES	SEC CLASS	DATA TYPE & DEL TIME	DEL AGENCY
	PRELIMINARY DATA										
1	XY (A7)	To T-30 sec	Radar	20 sps	10 sps	Ft	WSCS	Plot -1	U	1 Hr	NR-A
2	HY (A7)	"	"	"	"	"	"	"	"	"	"
3	XY (Unit 1)	Entire Flight	"	"	"	"	"	"	"	"	"
4	HY (Unit 1)	"	"	"	"	"	"	"	"	"	"
5	XY (Unit 4)	"	"	"	"	"	"	"	"	"	"
6	HY (Unit 4)	"	"	"	"	"	"	"	"	"	"
7	XY (Unit 2)	AOS to LOS	AME	"	"	"	"	"	"	"	"
8	HY (Unit 2)	"	"	"	"	"	"	"	"	"	"
9	XY (Unit 3)	"	"	"	"	"	"	"	"	"	"
10	HY (Unit 3)	"	"	"	"	"	"	"	"	"	"
	FINAL DATA										
11	Smooth Pos XYZ (A7)	T-180 to T-30	Radar		10 sps	Ft	WSCS	Listing-1	U	20WD	"
12	Velocity V_x, V_y, V_z, V_t (A7)	"	"	"	"	Ft/sec	"	"	"	"	"
13	Smooth Pos XYZ (Unit-1)	Entire Flight		"	"*	Ft	"	"	"	"	"

REMARKS:

*The data rate should be 1 sample/sec after T+120 seconds.

STEWS-NR-P Form 6 (Rev)
1 Aug 78

Replaces STEWS-NR-P Form 6, 1 Apr 74, which is obsolete.

STEWS-NR-P SOP 70-10c

OD NO: 97916A	DATA PROCESSING CAPABILITY ESTIMATE	REVISION NO:	OBJECT: A7 and Drop Units	PAGE 2 OF 2
TDS PARAGRAPH 4100		OR TEST DESIGNATOR(S):	OBJECT REFERENCE: N/A	

DATA ITEM		DATA COLLECTION			DATA PROCESSING						
LINE NO	PARAMETER	PERIOD OR SEGMENT	DATA SOURCE	SAMPLE RATE	DATA RATE	1-SIGMA ERROR EST & UNITS	REF/ COORD	MEDIUM & COPIES	SEC CLASS	DATA TYPE & DEL TIME	DEL AGENCY
14	Velocity V_x, V_y, V_z, V_t (Unit 1)	Entire Flight	Radar	20 sps	10 sps*	Ft/sec	WSCS	Listing 1	U	20 WD	NR-A
15	Smooth Pos XYZ (Unit 4)	"	"	"	"*	Ft	"	"	"	"	"
16	Velocity V_x, V_y, V_z, V_t (Unit 4)	"	"	"	"*	Ft/sec	"	"	"	"	"
17	Pos XYZ (Unit 2)	AOS-LOS	AME	"	10 sps	Ft	"	"	"	"	"
18	Pos XYZ (Unit 3)	"	"	"	"	Ft	"	"	"	"	"

REMARKS:

*The data rate should be 1 sample/sec after T+120 seconds.

STEWS-NR-P Form 6 (Rev) 1 Aug 78 — Replaces STEWS-NR-P Form 6, 1 Apr 74, which is obsolete. — STEWS-NR-P SOP 70-10c

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APPENDIX C

SAFETY PLANS AND SOPS

C-1. Safety Standing Operating Procedures
C-2. FCTOH Safety Plan for HE Test
C-3. MILL RACE Safety Plan
C-4. Standing Operating Procedure for Explosive Operations for MILL RACE
C-5. Standing Operating Procedure for Explosive Operations for MILL RACE
C-6. Standing Operating Procedure for Explosive Operations for MILL RACE

APPENDIX C-1

DEPARTMENT OF THE ARMY *WSMR Reg 385-15
WHITE SANDS MISSILE RANGE
White Sands Missile Range, New Mexico 88002

Regulation
No. 385-15 10 April 1972

Safety

SAFETY STANDING OPERATING PROCEDURES

TABLE OF CONTENTS

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Responsibilities	5	2-3
Procedures	6	3-4
References	7	5
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Appendix B. SOP Format for Operations Involving Ionizing Radiation		B-1
Appendix C. SOP Format for Operations Involving Electromagnetic Radiation		C-1
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1. PURPOSE. To prescribe policy, procedures, and responsibilities relating to the development and approval of Safety Standing Operating Procedures (Safety SOPs).

2. SCOPE. Applicable to all organizations and agencies engaged in hazardous operations at or under the jurisdiction of the White Sands Missile Range (WSMR). Excepted are those tenant organizations which are specifically excluded by separate contracts or agreements approved by the Commanding General, WSMR.

3. DEFINITION. Hazardous Operations. Operations involving propellants, explosives, or ammunition; highly flammable or toxic products; high pressure gases; ionizing radiation; microwave emission; laser/maser experimentation; and any other operation which the Chief, Safety Office determines to be hazardous.

4. POLICY. In compliance with USAMC Regulation 385-100, an approved Safety SOP is required for each hazardous operation. The SOP will provide Detailed Operating Instructions (DOI) for each phase of the operation. Applicable portions of the approved Safety SOP will be conspicuously posted at the site of each operation. Exceptions to the SOP requirements may be made as follows:

*This regulation supersedes WSMR Regulation 385-15, 29 September 1970.

a. For one-time operations, the Chief, Safety Office may, at his discretion, accept a request on DA Form 2496 in lieu of a formal SOP. Such requests will specifically indicate the nature and location of the proposed operation and identify the hazards involved and the safety measures designed to minimize such hazards.

b. SOPs for radar operations will provide, in lieu of the DOI, identification of all safeguards and safety procedures which will be employed to insure safety of operations. The SOP will also identify hazardous areas, including "limited occupancy" and "denied occupancy" areas and "aircraft exclusion zones," and general warning signs as applicable, and will specify controls to be exercised over such areas.

5. RESPONSIBILITIES.

a. The Chief, Safety Office will:

(1) Establish safety standards and requirements.

(2) Assist chiefs of organizations and supervisors in the identification of hazards and required protective measures and/or equipment.

(3) Coordinate with chiefs of organizations in the development of Safety SOPs for hazardous operations.

(4) Coordinate with the Installation Surgeon in all matters relating to health aspects of environmental hazards including, but not limited to, ionizing radiation, microwave emission, laser/maser operations, and toxic materials.

(5) Review and approve for Command all Safety SOPs pertaining to hazardous operations.

(6) Conduct periodic inspections of hazardous operations and/or areas to insure compliance with applicable Safety SOPs and other pertinent safety requirements.

b. Chiefs of organizations will:

(1) Coordinate with the Chief, Safety Office to insure identification of all hazardous operations and/or areas.

(2) Require development of, and compliance with, Safety SOPs and other pertinent criteria for hazardous operations.

(3) Take necessary action to insure a copy of Safety SOPs are available on site pertinent to operations(s) being conducted in accordance with same.

c. Supervisors will:

(1) Maintain continuing surveillance of operations and/or facilities to insure prompt identification of actual or potential hazards.

(2) Maintain adequate and timely safety SOPs for hazardous operations.

(3) Enforce Safety SOP requirements and other applicable Safety criteria.

d. Each individual is responsible for compliance with applicable Safety SOPs and other pertinent Safety instructions.

6. PROCEDURES. The following procedures apply to the preparation, approval, publication, and revision of all SOPs, with exceptions as noted in paragraphs 4a and 4b, above.

a. Preparation of Safety SOPs.

(1) Safety SOPs will conform insofar as possible to the applicable formats outlined in Appendixes to this regulation. If none of the existing formats are applicable, the Safety Office will furnish necessary guidance.

(2) The Safety SOP will contain DOIs for each hazardous operation. The DOI will also specify:

(a) Applicable safety protective clothing and equipment requirements.

(b) Static grounding requirements where applicable.

(c) Safety inspection and equipment requirements.

(d) Other applicable safety requirements.

(3) Manufacturers' instructions, technical publications, engineering orders, and similar documents may be submitted for approval in lieu of the DOI. Such documents must include or be accompanied by a statement identifying the source and the applicable portions of the publication.

(4) The SOP will be written in segments so that applicable portions can be posted at point of operation.

(5) Each Safety SOP relating to hazardous operations will include appropriate emergency procedures and procedures for disposal of hazardous material.

b. Preliminary Approval. Safety SOPs will be prepared in draft form and presented to the Chief, Safety Office for preliminary review and comment. The Chief, Safety Office will at this time effect any coordination required by paragraphs 5a(3) and (4), above. A minimum of ten workdays are required for Safety Office review. The only exceptions to this will be in case of emergency.

c. Final Approval and Publication.

(1) Following preliminary approval, draft SOPs will be prepared in final form on multilith duplimat masters or other reproduction media. The originating organization will obtain any concurring signatures specified by the Chief, Safety Office under provisions of paragraph 5a, above. The SOP will then be forwarded to the Chief, Safety Office for final approval, signature, and numbering.

(2) The signed and numbered SOP will be reproduced by the originating organization and distributed to all interested activities and concurring agencies. Three copies of each SOP will be furnished to the Safety Office, which is the office or record.

d. Revision.

(1) Originating agencies will revise each SOP as necessary, to insure its timeliness and adequacy. Each SOP will also be reviewed at least annually by the originating agency to determine the need for changes and/or additions. If no revision is required, the Safety Office will be so informed in writing.

(2) When a program is completed or cancelled and a SOP is no longer required, the Safety Office will be notified so the SOP can be rescinded. Revisions will be prepared and published in the same manner as the original SOP. Each revised page will bear the same number as the original page. When a revision has been approved, the original page will be withdrawn and the revised page inserted in the SOP. Revisions will be chronologically numbered, beginning with "1."

7. REFERENCES.

a. AR 40-5
b. AR 385-10
c. TB MED 270
d. TB MED 279
e. USAMC Reg 385-1
f. USAMC Reg 385-9
g. USAMC Reg 385-25
h. USAMC Reg 385-29
i. USAMC Reg 385-100
j. USATECOM Reg 385-9
k. WSMR Suppl 1 to AR 385-32
l. WSMR Reg 40-8
m. WSMR Reg 40-9
n. WSMR Reg 385-5

(SF)

APPENDIX C-2

FCTOH Safety Plan for HE Test

1. PURPOSE

The purposes of this document are to consolidate those policies, responsibilities, and safety materials that are common to all Field Command, Defense Nuclear Agency (FCDNA) non-nuclear (above ground) high explosive tests and to provide a media to be supplemented by the Test Group Director (TGD) for each test to delineate the specific safety hazards anticipated that are unique for that test.

2. SCOPE

This document presents the safety policies and reference materials that are pertinent to the FCDNA high-explosive testing program. It is intended to provide guidance and controls for dealing with hazards that are associated with high-explosive tests.

3. APPLICATION

This document is applicable to all above ground high-explosive tests, regardless of test location. All participating organizations will comply with the policies contained herein. The TGD may permit variance if, in his judgment, the test cannot be otherwise accomplished. In such cases, adequate alternative safety procedures will be established, approved, and published. When a conflict exists between the requirement of this document and other instructions or procedures, the procedure providing the most stringent or highest degree of protection will be followed. Decisions of technical interpretation will be refined through the TGD to the FCDNA Safety Engineer/Officer for resolution. Mandatory safety requirements are indicated by the use of "will" or "shall."

4. DEFINITIONS

a. Hazard Classification --

Class 1 - Safe. No hazard to personnel, experiments or test system components.

Class 2 - Marginal. Potential hazard to personnel and experiments and/or test system components which can be controlled by special handling and minimum use of protective clothing and equipment.

Class 3 - Critical. Could result in injury or illness to personnel, extensive damage to experiments and/or test system components unless controlled by limiting personnel access or by using special protective clothing and equipment and/or remote handling devices.

Class 4 - Catastrophic. So hazardous that no preventive or protective measures can be taken to reduce a hazard below a calculated risk.

b. Prearming -- The act of inserting a detonator or detonators into an explosive charge or experiment.

c. Arming -- The act of removing the shorting cap or plug from firing cables that are inside a primary lockout, testing for extraneous currents, and connecting for firing.

d. Limited Access Zone -- A zone in which access to work areas is restricted to those persons directly involved in handling hazardous items and/or participating in a specified hazardous operation (normally for a specified time).

e. Controlled Access Zone -- Same as "limited access zone" except that access is allowed to those activities and personnel which produce minimum interference with the specified hazardous operation.

5. GENERAL

It is the policy of FCDNA to ensure that test technical objectives are accomplished within the constraints imposed by the need to provide an operational environment which will:

a. Avoid loss of life or injury to personnel.

b. Preclude damage or destruction of equipment.

The DOD/FCDNA and DOD/FCDNA contract agencies will obtain approval of the installation safety officer prior to initiating any hazardous operations or introducing hazardous materials. Test personnel will conform to the industrial safety standards and codes contained in the references of Section 17, and to those prescribed by the disciplines of Fire Protection, Environmental Control, Industrial Hygiene, Sanitation, Ionizing and Non-Ionizing Radiation, Medical Support, and Traffic Safety.

6. GENERAL RESPONSIBILITIES

a. Manager, NVOO or Chief, Safety Office WSMR: Has overall responsibility for the health and safety of all personnel and the general public at their respective installation.

b. Test Directorate, Field Command: Within Field Command, FCT is responsible for safety activities at DOD/FCDNA test sites and has direct responsibility for the safety of assigned personnel. The responsibility is executed through:

(1) The FCT Safety Engineer who provides technical advice and assistance.

(2) The TGD who is responsible for coordinating and controlling those test activities which fall within his purview during the fielding period. He is directly responsible through his military chain of command for the safety of all personnel assigned or attached to his staff.

7. SPECIFIC RESPONSIBILITIES

a. Test Group Director:

(1) Will publish and distribute a test safety supplement as required by this document. The supplement will implement this document for the specific test and will address the unique hazards associated with the test. The analysis of the hazards associated with the experiments, when approriate, may be issued at a later time under a separate cover. Both portions of the supplement will be completed and distributed prior to beginning field assembly and installation.

(2) During the fielding phase, will formally assume responsibility for the test site.

(3) Will be responsible for the safety of all personnel and equipment assigned to the test site.

b. Test Group Safety Officer:

(1) Will be the primary contact for safety for the specific test.

(2) Will provide safety coordination and administrative assistance to the TGD and project agencies.

(3) Will collect all safety documentation from project agencies.

(4) Will supervise the preparation and implementation of the Event Test Safety Plan.

c. Test Group Safety Engineer (TGSE) (when assigned):

(1) Will provide technical advice and assistance to the TGSO as required during the planning and execution phases of the specific test.

(2) Will provide the staff support required to assist the TGD in the execution of the safety documentation and safety coordination responsibilities. Safety responsibilities includes but is not limited to:

(a) Identifying potential hazards unique to the designated area, facility, site, or operation which is outside the normal hazards associated with the construction crafts involved.

(b) Assuring that all other organizations have adequate procedures for safely conducting their portions of such work.

(c) Developing procedures for coping with such hazards if required.

(d) Assuring that precautionary procedures associated with such hazards are known to individuals entering the area.

(e) Assuring that work activities within the test site are operationally compatible and do not adversely affect the health and safety aspects of any other operation(s).

(f) Assuring that fire protection, medical facilities, trained first aid personnel, and related supplies are available during all working hours, commensurate with the hazards involved.

d. Project Agencies:

Each agency Project Officer will insure that all agency personnel participating in DOD/FCDNA tests comply with the safety requirements included in this document. The Project Officer will comply with the instructions of the TGD on all items related to safety.

(1) Experiment Safety. Each project agency providing experiments for a test will identify and report all hazards and will develop and promulgate written procedures for its employees to insure safety during experiment installation, checkout, and recovery. These procedures will be made available for review by the TGD, if so requested, not later than 90 days prior to fielding. These procedures will describe all hazardous materials and items included in the experiment and associated hardware. Each time a change is made in the originally reported hardware which modifies safety requirements, the agency making the change will submit a notice of such change to the TGD. Prior to fielding, the notice is due within 5 days of any experimental change. After fielding, the notice will be submitted within 1 day after the change has been made to the hardware.

(2) Containment of Explosives, Propellants, and Pyrotechnics. Project agencies fielding experiments including quantities of explosives, propellants, or pyrotechnics which have a potential hazard of Class 3 (Critical) or Class 4 (Catastrophic) (see Section 4 for definitions) will insure that their experiments do not produce potential dangers to adjacent experiments. The TGD may require agencies to demonstrate containment of their samples prior to their deployment to the field. Those agencies fielding experiments including quantities of explosives or pyrotechnics which have a potential hazard of Class 2 (Marginal) may certify containment of their samples, in writing, to the TGD. No explosive, propellant, or pyrotechnic sample will be shipped to the test location or installed without prior approval of the TGD.

8. ACCIDENT REPORTING AND INVESTIGATION

a. Reporting Responsibilities and Procedures

(1) Each person participating in a DOD/FCDNA test is responsible for reporting to his Project Officer or supervisor every industrial injury which he sustains.

(2) The Project Officer, supervisor, or other responsible individual at the scene of mishap will:

(a) Obtain the required emergency services by following the emergency instructions applicable to that area.

(b) Report any accident involving a disabling injury or any accident which would adversely affect an experiment to the TGD or TGSE by the most expeditious means.

(3) The TGD will report all occurrences defined by local health and safety standards as soon as possible. The TGD also will report these occurrences to FCDNA.

b. Accident Investigations. The TGD will investigate all accidents in which DOD/FCDNA personnel, experimenters, or contractors are involved and report the findings as required by existing DOD regulations.

9. PROTECTIVE CLOTHING AND EQUIPMENT:

All participating organizations will provide their personnel with the necessary personal protective clothing and equipment for use during operations in which personnel hazards exist. Participating organizations will provide, for example, hardhats, safety shoes, protective goggles or glasses, and special equipment for specific ordnance tasks, such as nonstatic clothing, conductive footwear, etc.

10. EXPLOSIVES

Explosives will be handled, transported, and stored in compliance with total health and safety standards. The TGD has jurisdiction over all explosives in, or related to, test system components and experiments, and will be notified prior to their arrival at the test site. Separation of potentially hazardous explosives from inhabited structures will be based upon appropriate quantity-distance tables.

a. Transportation. The transportation of all explosives related to test system components and experiments is under the jurisdiction of the TGD.

(1) Vehicles. Vehicles used for the transportation of explosives must meet the requirements of the installation safety plan. Approved vehicles must carry appropriate fire-fighting equipment, explosive tie-downs, signs, and other safety equipment as required by installation authorities. Explosives will be transported into or out of the test site only after the responsible agency has developed plans for these operations and the plans have been approved by the TGD.

(2) Handling. All handling operations will be conducted during daylight hours and must follow a detailed procedure that has been approved by the TGD.

(3) Storage. The TGD will arrange for appropriate explosives storage magazine(s) for use by FCDNA agencies and contractors. The TGD will be notified of requirements for storage at least 2 weeks before the explosives are scheduled to arrive at the test location. Normally, explosives will be stored only in magazines; however, interim short-term storage may be permitted in other areas of the test site when specifically approved by the TGD. Explosives will be stored in accordance with explosives compatibility requirements; that is, initiating explosives and devices, chemical munitions, and bulk explosives will be stored in separate magazines. All magazines or storage facilities will be located so as to be in compliance with the quantity-distance tables. Storage facilities will be locked except when storage or removal of contents or maintenance of the facility is taking place. Access to this facility will be controlled and scheduled through the TGD.

(4) Personnel and Equipment. A minimum of two persons must be present during work with explosives. One of these will be a qualified explosives engineer or a technician specifically trained for these operations. The TGD may review the qualifications of all explosive handlers. All personnel working on explosives which are not fully contained will wear eye protection, grounding straps, nonstatic clothing (cotton), and nonconductive boots. Explosive electrical components will be isolated from all sources of extraneous current by keeping these components and all associated objects at electrical ground. The electro-explosive device, work stands, handling equipment, power supplies, and all related objects will be grounded. If it is necessary to use power tools or photographic equipment in close proximity to explosives, usage will be approved by the TGD.

(5) Fire Hazards. No smoking, matches, or spark-producing or flame-producing devices (cutting or welding) will be permitted inside the storage magazine or within 50 feet (15.2 meters) of any exposed or uncontained explosives. The operation of motor vehicles will be restricted as provided by the installation safety plan.

(6) Electrical Storms. Because there is no positive means of rendering electrically fired explosives totally insensitive to induced electrical current, all operations involving explosives will be terminated upon the approach of an electrical storm or thunderstorm. The approach of a storm is indicated by a change in the potential gradient. The criterion for termination of operations will be a gradient of 1500 volts per meter on a potential gradient meter and visual observation of lightning flashes. Note: The potential gradient meters have been known to alarm erroneously due to static electricity induced by blown dust. The TGD is responsible for the installation of the lightning-detection system (probe and readout) and for ordering an evacuation. A plan of storm warnings shall be made by the TGD based on the susceptibility, location, and potential effect of an inadvertent initiation of explosives, and shall contain, but not be limited to, the following:

(a) The method or system that will be used for ordering an evacuation.

(b) Designation of the individuals who have the authority in the various areas of the test site to order an evacuation.

(c) Location of the monitor probe.

(d) Location of the monitor readout so that it can be observed prior to and during explosive handling operations.

(e) Areas to be evacuated, designated actions personnel are to take, and designated areas to which personnel are to go.

(7) Instrumentation and test equipment. An explosive that is instrumented will be handled in the same manner as one having detonators. When not in use, the instrumentation leads will be connected together and grounded.

(8) Radio Transmitters and Transceivers. Portable or mobile AM/FM transmitters or transceivers will not be operated in an area where detonators are being moved or handled.

(9) Lockouts. All firing, instrumentation, or diagnostics cables associated with explosive system(s) and/or experiments will be shorted and broken by a primary lockout near to the explosive item. A secondary lockout shall be located at a point remote to the explosive.

11. COMPRESSED GASES

a. Storage and Use. High pressure gas cylinders will be stored in a cool area, all standing bottles will be secured with safety chain, cylinders that are not upright will be blocked to prevent rolling or will be placed on pallets designed for that purpose. Valve-cap covers will be in place at all times when cylinders are not in use.

b. Compressed Air. Compressed air and other compressed gases will not be used to blow dirt, chips, or dust from clothing which is being worn. The use of compressed air or gas for cleaning machines, tools, or parts will be so controlled as to preclude the possibility of injury and will be regulated to a maximum nozzle output of 30 psi. Eye protection will be worn when items are being cleaned with compressed air or gas.

c. Inert Gases. Nitrogen and argon are the two most prevalent inert gases in use. Helium is used to a lesser extent for special purposes. The primary safety hazard in confined areas is that of asphyxiation due to the exclusion of oxygen. Precautions will be taken to preclude the oxygen level to drop below 20 percent.

d. Pressure Testing. The use of compressed gases for testing pressure vessels will not be permitted unless there is a pressure relief device in the supply line of adequate size to relieve the pressure and set to operate at 110 percent of the working pressure of the vessel.

12. PREARMING AND ARMING

All prearming and arming plans will be approved by the TGD prior to the installation or connection of a firing system. The prearming will be accomplished at the latest possible time, after all other work possible has been accomplished, using a published, prearranged checklist to insure completion of all necessary items.

13. TIMING AND FIRING

The timing and firing of an event normally will be accomplished by a contractor specifically retained for this purpose. The test supplement will contain detailed information about the timing and firing. Upon authorization of the TGD, the secondary lockouts may be removed and normal countdown begun.

14. ELECTRICAL POWER

The type of electrical power available generally will vary with remoteness of the test area. Whenever available, standard commercial power will be used to supply the utility and instrumentation power. When portable generators are used, their use shall comply with local installation regulations. Refueling of these units shall comply with local installation regulators. In general, at arming, all utility power will be terminated at the test location.

a. Portable Lighting. The use of portable electrical power for lighting at the test area will be minimized. When operational requirements dictate a variance to this policy, such lighting will be located so as to preclude danger to personnel and inadvertent initiation of the explosive. Note: Some portable generators create noise louder than the 90 dB-level. These units therefore should be located as far as possible away from the operation. When servicing these units, personnel should wear protective devices.

b. Batteries. The capacity of batteries shall be the minimum consistent with the power requirements. Batteries that are pressurized or vented which contain toxic, combustible, or explosive oxidizers and/or electrolyte, will not be used without prior specific approval of the TGD.

c. Electrical Components. Relay contacts, capacitor discharge circuits, and other components that will have power on or after zero time and that can arc or generate heat shall be of a type that will operate safely in a combustible or explosive environment. Positive control of these circuits will be maintained by discontinuing the power to them should an indication of an explosive atmosphere be obtained.

15. POSTEVENT REENTRY

a. General. Although reentry at the earliest possible time is desirable, primary emphasis will be given to personnel safety. All operational directions concerning reentry will be initiated by the TGD and issued to the Officer in Charge of reentry for the event, and then to the reentry participants. At the discretion of the TGD, operational control of reentry may be released to the DTGD. The reentry shall proceed according to the plan established by the test supplement. No entry into the test area will be made until all dust, debris, and smoke from the event has settled or dissipated.

b. Hazards Evaluation. The reentry party shall enter to inspect and evaluate the test area for loose explosive or toxic materials which have sublimated or spalled and other conditions that might present a hazard to those personnel who will assess experiment damage and general recovery. Whenever possible, hazards found shall be safed and/or cleaned from the area. Where hazards cannot be removed or made safe, personnel who enter these areas will be provided and shall use appropriate protective equipment. With the possible exception of individuals recovering film from known safe areas, no personnel shall be permitted to enter the test site until the reentry party has concluded its evaluation and declared that there are no other hazards requiring immediate action.

(1) Experiment Recovery. Recovery of the individual experiments shall be accomplished in accordance with a priority list established by the TGD and TD. Each project officer shall be responsible for the removal of his experiment from its location.

(2) Hazardous Material Processing. Experiment processing from the test area shall be in accordance with procedures established by the TGD. Those experiments containing explosives, explosive components, or pressurized components that cannot be depressurized shall be taken from the test area to an explosive storage area for packaging, and shipping to experimenters.

16. TEST SUPPLEMENT

a. General. The TGD of each test will supplement this document with information about hazards and safety requirements that are peculiar or unique to that test, and with procedures for adequately controlling those hazards so as to prevent injury to personnel and damage to equipment.

b. Requirements. The supplement will contain as a minimum, but need not be limited to, the following:

(1) A diagram indicating the configuration of the test as it will be installed.

(2) A diagram of the limited and controlled access zones to be established during the fielding of the test.

(3) A table or other media indicating the personnel and activity restrictions which will contain, but need not be limited to, the following information:

(a) Each piece of equipment or operation for which a safety zone needs to be estalbished.

(b) The task or activity to be accomplished.

(c) The magnitude or class of hazard.

(d) An indication as to which personnel will be allowed to penetrate the zone to accomplish the task or activity.

(4) A statement or list of personnel to whom the TGD desired to delegate the authority to act in his name to meet the requirements of this document.

(5) The nomenclature and quantity of all explosive components of:

(a) The main charge and booster assembly for the test.

(b) Any experiments of the test.

(c) Any calibration test prior to the main test.

(6) Special provisions for post event shipping.

c. Timing & Firing

(1) In general, all HE tests will be timed and fired by an FCDNA contractor. The contractor shall be named by the event supplement and will supply a firing system diagram.

(2) Diagram. The firing-system diagram shall include an indication of the system used to fire the test, including the monitoring circuits, and other pertinent data.

(3) Location. The event supplement shall contain a diagram showing test layout with ground zero, firing location, manned stations, instrumentation facilities, and other pertinent safety data.

(4) Safeguards. In addition to the primary and secondary lockouts, the preconnected circuit test, and other operational safeguards, the TGD will publish prior to the execution of the test a plan that will:

(a) Specify a schedule of prearming and arming.

(b) Indicate those who are to be members of the arming team.

(c) Define the interface between the experiments and the timing-firing agency, if any.

d. Misfires. The test supplement shall contain detailed information on what to do if the test does not execute as planned.

17. REFERENCES

a. FCDNA INSTR 4165.4 SUBJ: FIRE PREVENTION at FCDNA DTD 1 Sep 76

b. DNA INSTR 5000.36 SUBJ: SYSTEM SAFETY ENGR & MANAGEMENT 21 Mar 80

c. DNA INSTR 6055.2 SUBJ: PERSONAL PROTECTIVE EQUIPMENT 29 Aug 78

d. FCDNA SUPPL 1 TO DNA INSTR 6055.1 SUBJ: OSA PROGRAM 8 May 80

e. FCDNA SUPPL 1 TO DNA INSTR 1000.19 SUBJ: MISHAP INV. REP/REC KEEPING 9 May 80

f. FCDNA INSTR 3200.5

g. AMCR 385-100 DARCOM CHAPTER 14, SUBJ: SAFETY

APPENDIX C-3

MILL RACE SAFETY PLAN

APRIL 1981

DEFENSE NUCLEAR AGENCY
TEST DIRECTORATE
FIELD COMMAND
KIRTLAND AFB, NEW MEXICO
87115

MILL RACE SAFETY PLAN

SSOP # NR-PD-23-81

3 April 81

APRIL 1981

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SECTION I
INTRODUCTION

A. PURPOSE

The purpose of this document is to provide the nucleus of the Safety Plan for MILL RACE, a Defense Nuclear Agency (DNA) high explosive (HE) test to be conducted near the Trinity Site at White Sands Missile Range (WSMR).

B. SCOPE

This plan presents safety policies, hazards, and reference material pertinent to MILL RACE test bed construction and to the MILL RACE experiments. It is intended to supplement WSMR Regulations and FCDNA Instructions by providing controls and guidance for dealing with hazards that will exist at the MILL RACE Site. Hazards associated with MILL RACE are discussed in Section V.

C. APPLICATION

All participating organizations, except WSMR personnel, shall comply with the policies contained herein. The Test Group Director (TGD), with the concurrence of the Chief, Safety Office, WSMR, may permit variations if, in his judgment, such variations are necessary for successful execution of the test. In such cases, adequate alternate safety procedures will be published as a supplement to this document. When a conflict exists between the requirements of this document, FCDNA Instructions, WSMR Regulations, or those of a participating agency or DOD contract agency, the procedure providing the more stringent or higher degree of protection will be followed. Questions of technical interpretation will be referred to the TGD for resolution. Mandatory safety provisions are indicated by use of the word "shall".

D. REFERENCES

1. FCDNA Instruction 3200 Series
2. WSMR Regulation 420-3, Fire Regulations
3. WSMR Regulation 385-15, Safety Standing Operating Procedures
4. U. S. Army Materiel Command AMCR 385-100, Safety Manual
5. U. S. Air Force Regulation 127-101
6. CFR Title 29, Part 1926, Subpart U, Blasting and Use of Explosives

SECTION II
DEFINITIONS

A. HAZARD CLASSIFICATIONS

<u>Class 1 - Safe</u>. No hazard to personnel, experiments, or test system components.

<u>Class 2 - Marginal</u>. Potential hazard to personnel, experiments, and/or test system components which can be controlled by special handling and minimum use of protective clothing/equipment.

<u>Class 3 - Critical</u>. Could result in injury or illness to personnel or extensive damage to experiments and/or test system components unless controlled by limiting personnel access, or by using special protective clothing/equipment and/or remote handling devices.

<u>Class 4 - Catastrophic</u>. So hazardous that no preventive or protective measures can be taken to reduce this hazard below a calculated risk

B. LIMITED ACCESS ZONE

A zone in which access to work areas is restricted to those persons directly involved in handling the hazardous items and/or participating in the specified hazardous operation (normally for a specified time).

C. CONTROLLED ACCESS ZONE

Similar to "Limited Access Zone", but allows those activities and personnel which have minimum interference with the specified hazardous operation, as determined by the TGD.

D. TEST BED

The area surrounding ground zero (GZM) which encompasses all experiment emplacement, instrumentation trailer parks, and camera bunkers.

E. AGENCY PROJECT OFFICER

The individual charged with the field responsibility of installation, instrumentation, and recovery of experiments fielded on MILL RACE by his sponsoring agency.

SECTION III
RESPONSIBILITIES

A. DOD/FCDNA

It is the responsibility of FCDNA, as a user agency at WSMR, to insure that all MILL RACE operations on WSMR, which impact on safety and health, conform to:

1. U. S. Army Materiel Command AMCR 385-100, Safety Manual.

2. WSMR Regulation 385-15, Safety Standing Operating Procedures.

3. FCDNA Instruction 3200 Series.

FCDNA is responsible for coordination of all MILL RACE activities with Chief, Safety Office, WSMR.

B. DOD/FCDNA CONTRACT AGENCIES AND OTHER AGENCIES PARTICIPATING ON THE MILL RACE TEST

All MILL RACE agencies shall be responsible for:

1. The safe conduct of their operations at WSMR.

2. Coordination of hazardous activities with the TGD to prevent jeopardizing other experimenters and their equipment.

3. Reporting all accidents to the TGD.

4. Compliance with the requirements of WSMR Regulation 385-15.

C. WSMR PERSONNEL PERFORMING WORK ON MILL RACE

WSMR personnel are responsible, through their own organizations, to the Chief, Safety Office, WSMR.

SECTION IV
POLICIES

A. GENERAL

The policies set forth in this section are established to assist the TGD in fulfilling his responsibilities and to insure safe execution of the test. The TGD may delegate the MILL RACE safety responsibilities to a designated Safety Officer. Such delegation shall be only to a full-time member of the Test Group Staff who will be at the MILL RACE Site during the fielding, test, and experiment recovery phases. Prior to the beginning of the MILL RACE fielding phase, the TGD will solicit Safety Plans from all participating agencies. These Safety Plans will be reviewed by the TGD and either approved by him or returned to the agency with comments indicating revisions required. The approved Safety Plans will be included in Appendix A of this document, which will then constitute the MILL RACE Safety Plan. The MILL RACE Safety Plan shall be submitted to the Chief, Safety Office, WSMR, for approval (WSMR Reg. 385-15, Paragraph 4).

B. PARTICIPATING AGENCIES

1. The Project Officer (PO) for each agency participating on MILL RACE shall be responsible for the safety of his personnel and for the safe conduct of his agency's operations at the MILL RACE Site. Project Officers are listed in Appendix A. Each Project Officer shall prepare a Safety Plan for the MILL RACE activities and shall assist the TGD in modifying the plan, if necessary, so that it meets the approval of the TGD and the Chief, Safety Office, WSMR. The PO shall also assist the TGD in preparation of any reports or forms pertinent to his experiments that may be required by WSMR.

2. The agency's Safety Plan shall present those safe practices which are required for safe conduct of the agency's experiments and which are to be followed by agency personnel during the fielding, test, and experiment recovery phases. It shall emphasize hazardous materials and/or conditions that may be encountered during any phase, and shall provide detailed procedures to be followed in order to cope with such hazards. Each Safety Plan shall have a cover sheet which identifies the agency, experiment (by brief title and DNA experiment number), and which has approval signature spaces for the following:

a. Agency Project Officer

b. DNA Test Group Director

c. Chief, Safety Office, WSMR

3. Agency contractors and subcontractors will be considered to be a part of that agency. It shall be the responsibility of the agency PO to assure that such contractors and their personnel conform to the requirements of this document.

C. PERSONAL PROTECTIVE EQUIPMENT

All participating agencies shall provide their personnel with the necessary personal protective equipment for use during those operations in which personnel hazards exist. This equipment shall meet requirements and specifications of the Department of Labor and shall include items such as hardhats, safety shoes, protective goggles, and special equipment for specific tasks (e.g., nonstatic clothing, face shields, etc.).

D. MEDICAL EMERGENCIES

The TGD will arrange for and publish procedures for handling major medical emergencies. Participating agencies shall provide first aid supplies appropriate for the hazards involved in fielding their experiments. First aid supplies shall be maintained in a conspicuous and convenient location.

E. EXPLOSIVES

Explosives used at WSMR will be handled, transported, and stored in compliance with U. S. Army Materiel Command Regulation AMCR 385-100, Safety Manual; and CFR Title 29, Part 1926, Subpart U, Blasting and Use of Explosives, whichever is more applicable. The TGD has jurisdiction over all explosives related to MILL RACE and will be notified prior to their arrival at WSMR. A WSMR safety representative shall be included on the access lists for all explosives areas and shall be included as a member of the Prearming and Arming Party.

1. Transporting. The transportation of all explosives on WSMR related to MILL RACE is under the jurisdiction of the TGD. All explosives transported on WSMR must be carried in vehicles complying with Chapter 22 of AMCR 385-100 for transporting explosives. Approved vehicles must carry appropriate fire fighting equipment, including Class B-C portable fire extinguishers, explosives tie-downs, and other safety equipment. When carrying explosives, the vehicle must display ~~the~~ appropriate "EXPLOSIVES" signs.

Explosives shall not be transported into or out of the test system complex until after the responsible agency has developed plans for these operations and they have been approved by the TGD. Separation of personnel from potentially hazardous explosives will be based upon quantity-distance tables of AMCR 385-100.

NOTE: The TGD may permit transportation of 2 kilograms or less of explosives and the detonator on the same vehicle provided the detonator is carried in its shipping container and physically separated from the explosive.

2. Storage. The TGD will arrange for appropriate explosive storage magazines for use by DNA agencies and contractors. Requirements for storage will be made known to the TGD at least two weeks before explosives are due to arrive at WSMR.

3. Instrumentation. An explosive that is instrumented will be handled in the same manner as one having detonators. When not in use, the instrumentation leads will be connected together and grounded to the container.

F. LIQUID OXYGEN (LOX)

The TGD shall be notified of LOX deliveries to the MILL RACE test bed at least two working days before deliveries are to be made. The TGD shall then arrange for a fire truck and crew to stand by during all LOX transfer operations. Transfer operations shall not be undertaken unless there is a standby fire truck.

At least two persons qualified to handle LOX shall be suited in protective clothing for each handling operation. One member of the crew performing the LOX handling or transfer operations shall be designated to have full authority over all personnel and equipment in the immediate vicinity and shall be responsible for the safety of these personnel during the time required for the handling or transfer. Operations shall be performed only in open areas where good ventilation can be maintained. System materials which will come into contact with LOX shall have ductility and impact resistance suitable for the temperatures involved. Head, face, hand, and foot protection, as prescribed by the agency's approved Safety Plan, shall be worn during all operations involving LOX. Personnel protection and handling procedures shall conform to Paragraph 6-6 of AFR 127-101 (see Appendix B). In addition to the requirements of AFR 127-101, fresh air breathing equipment shall be maintained in readiness during LOX handling and transfer operations.

G. AIR TRAFFIC

Flight plans for all air traffic related to MILL RACE shall be submitted to the TGD for approval. The TGD shall then schedule a meeting with the Chief, Operations Control, WSMR, for coordination and final approval of the plans. In order to provide sufficient time for coordination with other WSMR activities, changes to flight plans after 8 April 1981 must be coordinated with the TGD and Chief Operations Control, WSMR. Because of the varied and continuing operations at WSMR, the requirement for advance approval of flight plans applies to dry runs as well as shot day activities.

H. ELECTRIC POWER

All electrical systems shall conform to the requirements of the National Electric Code. High voltage signs shall be posted in appropriate. conspicuous places. Generators shall be operated in accordance with the manufacturer's instructions and shall be operated only by qualified personnel. Generator pads, grounding, and fuel supply systems shall comply with WSMR Regulation 420-3, Appendix K, Paragraph 2. All instrumentation trailers using a floating ground reference during operations must be equipped with a positive earth grounding system for all electrical components, including power sources. This earth ground system shall be used at all times except during test operations. The grounding system shall include a red and green light warning system to visually identify whether the trailer is in the grounded or ungrounded configuration. The red light shall indicate the ungrounded configuration.

I. ELECTRICAL STORMS

The TGD shall be responsible for supplying potential gradient meters for use in determination of the approach of electrical storms. Explosive handling and any LOX transfer operations shall be terminated whenever electrical storms come within 5 miles of GZM.

J. FIRE PROTECTION AND REPORTING

The TGD shall arrange for fire protection for MILL RACE facilities. Fire extinguishers will be provided to agencies for the duration of the fielding phase when necessary to meet the requirements of WSMR Regulation 420-3. Locations and types of fire extinguishers shall be as prescribed in Appendix N, WSMR Regulation 420-3. Any fire, regardless of type or size, shall be reported. Fires may be reported by any of the following means:

1. Telephone: Dial 6-117

2. Radio: Any radio net having a base station with telephone communication.

3. Messenger: If neither telephone nor radio are available, a messenger shall proceed to the nearest telephone or fire station.

K. DESIGN SAFETY FACTORS

Following is a tabulation of minimum safety factors to be used in the design of test items.

Item	Factor of Safety for Personnel	Basis
Cable and Wire Rope	5	Material Ultimate Strength
Handling Equipment	4	Material Yield Strength
Cryogenic Systems and Materials	4	Material Yield Strength

NOTE: Application of safety factor where personnel are involved is: Load or pressure x safety factor = minimum design load or pressure. Where loads or pressures are to be test related only (that is, induced by the test), no factor of safety is required.

L. VEHICLES

Speed limits on WSMR numbered roads shall be as posted by WSMR. The maximum speed limit on all roads within the MILL RACE test bed shall be 15 miles per hour.

M. CONTROLLED ACCESS ZONES AND LIMITED ACCESS ZONES

Controlled Access Zones and/or Limited Access Zones have been developed on the basis of information provided by participating agencies. Maps indicating the limits of these zones and schedules showing the times that controls and limits are in effect are contained in Appendix E.

N. ANFO STACKING, PREARMING, AND ARMING

The agencies responsible for stacking the ANFO and for prearming, arming, and timing and firing shall develop detailed, written procedures for performance of each phase of their operations. These procedures shall comply with AMC Regulation 385-100 and WSMR Regulation 385-15 and shall includ whatever diagrams, drawings, and countdown checklists are necessary for clarity. No operations dealing with ANFO or the timing and firing system shall be undertaken until these procedures have been approved by the TGD and the Chief, Safety Office, WSMR. Assistance shall be provided to the TGD, by the ANFO stacking agency and the Timing and Firing agency, for preparation of forms and documentation required by WSMR, and for establishment of Controlled and/or Limited Access Zones required during delivery and stacking of ANFO and prearming/arming activities.

O. POSTSHOT

Postshot reentry into the test bed by experimenter personnel shall not be permitted until the Postshot Assessment Team has completed its survey and reentry is authorized by the TGD. The Postshot Assessment Team shall include a WSMR safety representative. Reentry and experiment recovery requirements shall be made known to the TGD no later than D-30 days.

SECTION V
HAZARDS

A. GENERAL

A variety of hazards will exist at the MILL RACE test bed, the most serious of which will be generated by MILL RACE activities. The MILL RACE generated hazards can be minimized by cooperation between agencies, by making all personnel aware of them, and by use of judgment in working with hazardous items. In addition to these hazards, there are natural hazards which exist because of the locale and environment. This section identifies the more serious haza... that will be encountered at the MILL RACE test bed.

B. EXPERIMENT HAZARDS

Appendix C is a tabulation which identifies MILL RACE experiments that either present hazards or are associated with hazardous operations.

C. NATURAL HAZARDS

Appendix D is an information pamphlet entitled "Safety Information for Newly Arrived Personnel", prepared and published by WSMR. All personnel assigned to, or visiting, the MILL RACE test bed should be provided with a copy of this pamphlet.

APPENDIX B

Excerpt from AFR 127—101 dated 4 September 1974

6—6. Oxygen (Liquid and Gas) Precautions and Safe Practices:

a. Liquid Oxygen. Liquid Oxygen is a pale blue, nontoxic, nonviscous, water-like fluid with a temperature of minus 299° F. below zero. It will boil at the extremely low temperature of minus 297° F. It is 1.14 times heavier than water and weighs 9.69 pounds per gallon. When heated, it turns back into a gas and will expand approximately 860 times its original volume at atmospheric pressure. One cubic foot of liquid oxygen (7.5 gallons) will expand to about 860 cubic feet of gas at 70° F. at sea level. Like most other fluids, oxygen can exist as a solid, liquid, or gas depending on the temperatures and pressures to which it is subjected. At atmospheric pressure, oxygen will be liquified if cooled below its boiling point: -297° F. However, the critical temperature of oxygen is -182° F. It cannot be liquified at temperatures higher than this under any pressure. As a liquid, oxygen is extremely fluid and will be attracted to an electromagnet much like iron. It will not burn itself, but will support combustion vigorously. This calls for extreme care in handling. Because oxygen will combine readily with other substances and actively support combustion, it will be used and stored under strict controls. Information is contained in TOs 15X—1—1, 42B—1—2, 42B5—1—2, 42B6—1—1; and AFM 92—1.

(1) Generating Liquid Oxygen. Oxygen generating equipment is composed of five main groups: power plant, air compressors, air purifiers, freon refrigeration, and air separators. The oxygen is made in, and used with, hydrocarbon-free materials. In the generating plants, oxygen will be permitted to come in contact only with materials known to be safe in an oxygen environment.

(a) Air Purifier Group. Dry air contains about .03 percent carbon dioxide which is enough to clog oxygen generating equipment by freezing in the lines. The air purifying equipment used for removing carbon dioxide is made up essentially of two vertical scrubbing towers that contain a water solution of caustic soda or potash, circulated by a motor-driven pump. Plant personnel will be particularly careful when preparing caustic solutions or draining and cleaning the system in the purifier; these solutions are very injurious to the skin and will damage clothing. Rubber gloves, aprons, and face shield or chemical goggles will be worn when caustic solutions are handled. Vinegar, boric acid, or dilute acetic acid will be used to neutralize the caustics if they accidentally come in contact with the skin. If neither of these neutralizers is immediately available, the burns will be washed profusely with clean water.

(b) Plant Location. Oxygen generating plants will be located at least 100 feet away from any structure, flight line aprons, and taxiways, and no less than 1,000 feet from runways. Also, generating plants will be located where they will not be subjected to excessive dust or dirt blown around by aircraft during runups or takeoffs AFM 88—15.

(c) Grounding. Oxygen generating equipment will be equipped with effective low resistance grounds to drain off accumulated static electricity.

(2) Liquid Oxygen Storage. Liquid oxygen storage and transfer tanks are provided in various sizes. A typical storage tank flow diagram is shown in figure 6—2.

(a) Filling Tanks. Tanks will be filled through liquid fill lines from the supply source. A properly designed liquid oxygen hose will be connected from the supply to the liquid line inlet. The vent valve and fill-drain valve are then opened and the liquid oxygen allowed to flow into the tank. Care will be taken to make sure the pressure buildup valve remains closed during tank filling. The initial amount of liquid entering the tank will evaporate immediately in cooling down the inside of the tank and the line

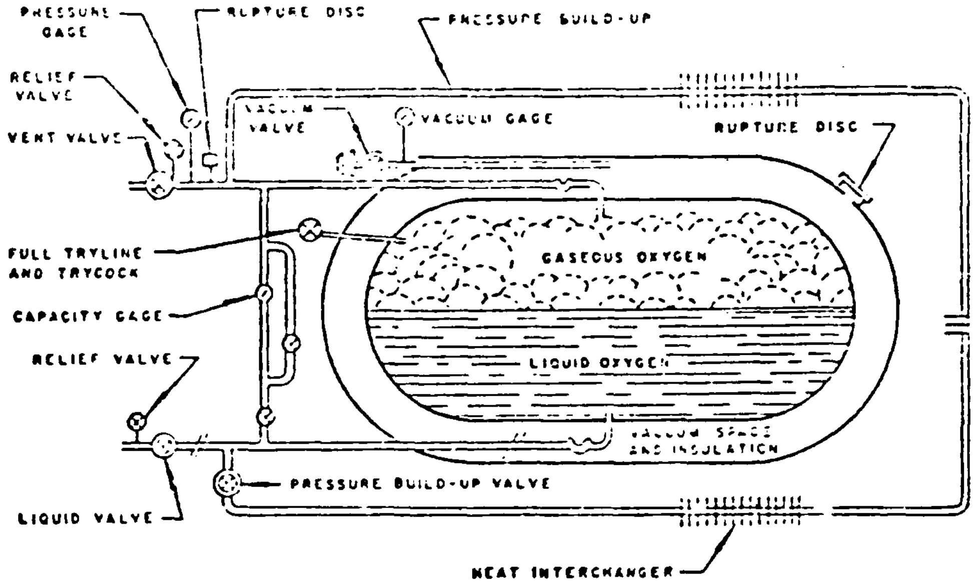

Figure 6—2. Liquid Oxygen Tank

connections. Because of this evaporation, the vent line will discharge large quantities of cold gaseous oxygen. When this discharge stops, it is an indication that liquid is accumulating in the tank. The liquid will continue to rise until some of it is dispelled from the vent or full tryline, depending upon which is provided. When this slight overflow is noticed, the supply will be stopped, the fill-drain valve on the tank closed, and the hose disconnected. Usually vent valves will be kept open just enough to maintain atmospheric pressure in the tank.

(b) Transfer Hoses. Hoses will always be disconnected immediately after ta[illegible] are filled. Because some liquid will be trapped in the hose and will continue to evap[illegible] it is possible for the hose to break because of pressure buildup. In order to prev[illegible] hoses from being damaged through failure to disconnect them, safety relief valves wil[illegible] provided on the tanks between the hose connections and the fill-drain, set to open at [illegible]sures well below those that could cause hose failure.

(c) Handling Hoses. Hoses and other oxygen equipment will be handled with care and stored in clean locations. Personnel will make certain no dirt, moisture, or other foreign matter enters hoses. Such matter would be carried into storage tanks. Some liquid may remain in transfer hoses after pressure has been released. Personnel will take extra care to avoid pointing these hoses at other persons when disconnecting the hoses from tanks.

(d) Storage Tanks. Oxygen tanks will be used only for storing and transferring liquid oxygen. To use this equipment with other liquified gases will contaminate it, making it unsafe for storing breathing oxygen. If a tank itself has been in storage, it will be thoroughly inspected before being filled with liquid oxygen. Each pipe and fitting will be free of grease or oil. The tank and all its components and connections will be thoroughly flushed and cleaned when there is any evidence or suspicion of contamination. The distance criteria for breathing and industrial liquid oxygen will be in AFM 88—15. When used as a propellant, quantity-distance criteria will conform to requirements in AFM 127—100. It will be as follows:

1. Fixed or portable tanks having a single or combined capacity of 100 gallons or less will conform to the requirements of NFPA Standards No. 51 and No. 56F.

2. Fixed bulk tanks having a single or combined capacity of more than 100 gallons will conform to the requirements of NFPA Standard No. 50, except the following minimum clearances will be provided:

a. Fifty feet from other tanks storing flammable liquids or gases.

b. Fifty feet from any type "C" (combustible) structures.

c. Twenty-five feet from any type "N" (noncombustible) structures.

d. Twenty-five feet from property lines.

e. Twenty-five feet from sidewalks, roadways or vehicle parking areas.

f. Fifty feet from railroads.

g. Seventy-five feet from aircraft parking, fueling or defueling areas.

3. Oxygen carts for serving breathing oxygen to aircraft will be parked in areas to maintain the following minimum clearances:

a. Seventy-five feet from aircraft parking, fueling or defueling areas.

b. Fifty feet from any type "C" (combustible) structures.

c. Twenty-five feet from any type "N" (noncombustible) structures.

4. Anhydrous Ammonia Tanks. When used as a propellant, quantity-distance criteria for anhydrous ammonia tanks will conform to the requirements of AFM 127—100 with the following exception: The minimum clearance from buildings, roadways, railroads, vehicle parking areas, other incompatible storage and aircraft parking, fueling and defueling areas, regardless of quantity, will be 50 feet.

(e) Lubrication. Because oxygen under pressure reacts so violently with grease or oil, no lubricant will be used on oxygen generating equipment or storage tanks except those specified by the appropriate lubrication charts. All oxygen handling equipment will be kept clean, dry, and free of oil or grease; fittings coated with moisture will freeze in position. Oil, grease, or other flammable substances will not be permitted to come in contact with valves, gauges, or fittings and personnel will not use pipefitting compounds containing grease. All excess grease will be cleaned from tank trailers after servicing operations.

(f) Relief Valves and Vents. Liquid oxygen tanks will be protected against pressure buildups by regulator relief valves preset to vent within structural limitations of the tank. To prevent dangerous accumulations of gaseous oxygen, discharge lines from liquid vapor relief valves will be led through oilfree pipes to the outside or the building at least 100 feet downwind from any flammable materials storage areas. Liquid oxygen will never be stored in containers not equipped with relief valves or rupture discs. In storage, liquid oxygen will never be confined in pipes or containers which may rupture when the liquid expands to a gas.

(g) Heat Protection. Normally, liquid oxygen storage tanks are not covered because of their special insulation. If a storage facility requires coverage, an open-shed structure of approved materials will be used.

(h) Fire Protection. Smoking and open flames will not be permitted within 50 feet of liquid or gaseous oxygen storage, transfer points, and generating plants. Suitable warning signs as described in chapter 4 will be posted to warn personnel of the fire hazard. Liquid oxygen storage tanks will be grounded to an approved static ground; liquid oxygen transfer trailers and storage tanks will be separated from other gas storage containers and flammable materials.

(i) Protective Clothing. Personnel handling liquid oxygen will wear knitted napped cotton-lined asbestos gloves with a gauntlet cuff and suitable goggles or face shield. One-piece coveralls are recommended, with the sleeves allowed to extend over the gloves and the trouser legs, without cuffs, over the shoes. Shoes will be laced tightly to prevent any spilled liquid oxygen from seeping inside. Personnel will not handle lines or fittings with their bare hands when the lines or fittings contain liquid oxygen. They will not permit spilled fluid to accumulate on any part of their bodies or clothing. Only tightly woven materials will be used for clothing worn in oxygen plants to prevent the liquid from seeping through.

(j) Personnel. Only fully trained and qualified personnel will be authorized to operate or handle any equipment involving liquid oxygen.

(k) Ventilation. Adequate ventilation will be provided in any area where liquid oxygen is stored or handled to prevent accumulations of combustion-supporting gases.

APPENDIX C

MILL RACE EXPERIMENT HAZARDS

DNA EXPERIMENT NUMBER	TITLE OR DESCRIPTION OF EXPERIMENT	HAZARDOUS MATERIAL		HAZARD CLASS		COMMENTS	AGENCY
		MATERIAL/ITEM	TYPE HAZARD*	PRESHOT	POSTSHOT		
2007	Thermal/Blast Response of Hardened Shelters	10 kW Gen TRS	E F,G,X	2 3	2 3	Generator will be running during test. Hazard due to TRS.	ERADCOM/HDL/BRL
2008	Blast Test of Hardened Tactical Shelter	10 kW Gen	E,F	2	2	Generator will be running during test.	ERADCOM/HDL/BRL
3001 thru 3006	NAVSEA Antennas	TRS	F,G,X	3	3	Hazard due to TRS.	NAVSEA/SAI
3007	NAVSEA Deckhouse	TRS	F,G,X	3	3	Hazard due to TRS.	NAVSEA/SAI
5501 thru 5503	Air Blast Extinction of Fires (Various Materials)	Cl. A Fuels TRS	F F,G,X	2 3	2 3	 Hazard due to TRS.	FEMA/SRI/LATA
6001	Ionospheric Response	5 kW of Pulsed C.W.	E	2	2	Duration of transmission ~30 min. to ~1 hr.	DOE/LANL/SRII
6501	Air Drop Pressure Measurements	Pressure Gages in Flare Canisters	Falling Objects	1	3	Dropped from altitude of ~40,000' above MSL 3 to 4 min. preshot.	LANL
7501	B-52's Overflights		Noise	1	2		SAC
8001	Large Air-Inflated Radome Air Blast and Thermal Hardness Trial	Fuel TRS	F F,G,X	1 3	2 3	Gasoline motor/compressor will run during test; hazard due to TRS.	UK/ASWE/SAI
8003	Hardened ADW Antenna Air Blast and Thermal Hardness Trial	TRS	F,G,X	3	3	Hazard due to TRS.	UK/ASWE/SAI
8004 and 8005	Miscellaneous Radar Items Air Blast and Thermal Hardness Trial	TRS	F,G,X	3	3	Hazard due to TRS.	UK/ASWE/SAI
8006	Antenna Reflector Slats Air Blast and Thermal Hardness Trial	TRS	F,G,X	3	3	Hazard due to TRS.	UK/ASWE/SAI
8007	Polemasts with Wraparound Antenna	TRS	F,G,X	3	3	Hazard due to TRS.	UK/ASWE/SAI
8009 and 8010	Passive Exposure of STIR Radar Assemblies and Materials	TRS	F,G,X	3	3	Hazard due to TRS.	UK/ASWE/SAI
8251	Composite Polymeric Tubes	TRS	F,G,X	3	3	Hazard due to TRS.	UK/AWRE/RARDE/SAI

MILL RACE EXPERIMENT HAZARDS (Continued)

DNA EXPERIMENT NUMBER	TITLE OR DESCRIPTION OF EXPERIMENT	HAZARDOUS MATERIAL		HAZARD CLASS		COMMENTS	AGENCY
		MATERIAL/ITEM	TYPE HAZARD*	PRESHOT	POSTSHOT		
8301	Dummies - Protective Clothing	TRS	F,G,X	3	3	Hazard due to TRS.	UK/AWRE/ SCRDE/SAI
8601	LAW 80	TRS	F,G,X	3	3	Hazard due to TRS.	UK/AWRE/ CLWT/SAI
9102	Dust Layer Sampling	Low Power Laser	R	2	2	Laser source fully contained.	DNA/TRE
9301	Drone's Overflight		Noise & Possible Falling Object	1	3	Unmanned aircraft.	DNA

*E - Electrical; F - Fire; R - Radiation; X - Explosion; G - Pressure Vessel (High Pressure Gas)

NOTE: Fire, pressure vessel, and explosive hazards associated with TRS are the responsibility of Science Applications, Inc. (SAI)

APPENDIX D

C O P Y

SAFETY INFORMATION FOR NEWLY ARRIVED PERSONNEL

1. Insects, Reptiles and Lizards

a. The Bee, Wasp, and Yellow Jacket. A bee will sting once and then die. A wasp or yellow jacket may sting several times; this may cause the blood pressure to fall and the person to collapse. Some people are more sensitive than others and should carry medication recommended by their doctor.

The stinger should be carefully removed with a scraping motion. Cold packs may give some comfort.

b. The Scorpion, Spider, Tarantula, Chigger, and Tick. The usual sting results in some swelling and discoloration, and sometimes in an allergic reaction. The sting of the more dangerous species of scorpions causes little or no swelling and no discoloration, but locally there may be a tingling or burning sensation. The poison acts mainly on the nervous system. If the sting does not involve one of the four extremities, ice applications are the only local first-aid measures.

Get medical attention as soon as possible for the scorpion, spider, or tarantula sting; the sting may need treatment to prevent infection. In the case of spider bites and you are some distance from a doctor or hospital, apply a constricting band (not a tourniquet) just tight enough to interfere with surface circulation. Loosen the constricting band in 5 minutes and then apply cold packs to the bite area.

c. Snakes. There are four kinds of poisonous snakes in the United States: rattlesnakes, copperheads, cottonmouth moccasins, and coral snakes. Most snake bite fatalities in this country are caused by rattlesnakes. They inject much venom if they are large and if they have not discharged their supply recently. They may also introduce tetanus germs as well as venom. The name "rattlesnake" is a common name for 16 species of the pit viper family.

When in snake-infested country, watch where you step, where you place your hands and where you sit. Over half of all bites are below the mid-calf, so it is wise to wear leather boots at least 10 inches high.

To prevent rapid absorption of the venom into the body, quickly place a tourniquet, string, shoelace, or whatever is handy, just above the site of the wound. Wash off surface venom if you can do it quickly. Call a doctor at once or take the person that was bitten to the hospital; do not permit them to run or exercise strenuously as this only spreads the venom throughout the body. If you are in the backwoods, try to remain calm. Sterilize a sharp knife or razor blade and carefully make a linear cut a quarter of an inch deep on each side of the fang punctures. Suction should be applied steadily for the first 2 hours. If suction cups are used, they should be removed for 10 to 15 minutes each hour thereafter.

It is important that the snake be killed so that it can be identified by doctors for administering the proper serum. Always assume that the snake is poisonous and get medical help as soon as possible.

d. The Gila Monster. This lizard is poisonous. Its bite may be serious or possibly fatal. The mortality rate is about 5 percent for children and one percent for adults. Do not kill or capture them--they are protected by state law; if you kill them, you may have a fine as well as a serious bite. Treat the bite the same as for a snake bite.

2. Rabies. Rabies continues to be a problem in New Mexico. Cases of rabies include dogs, cats, horses, goats, skunks, coyotes and bats. Any warm-blooded animal, including man, is susceptible to rabies.

Human exposures have occurred when persons were playing with or trying to pick up a strange or stray animal. However, most of the exposures were from privately-owned unvaccinated animals that were allowed to run loose. REMEMBER - a wild animal that can be approached by a human is likely to be sick. Leave it alone.

The rabies virus is carried in the saliva of the infected animal and is given to another animal or person through a wound in the skin, such as a bite or scratch. The virus then travels along the nerves to the brain. Death is almost a certainty at this point.

How to protect yourself against rabies if you are bitten.

a. Clean the wound with plenty of soap and water.

b. Report any animal bites to your medical personnel and supervisor.

c. Call the Security Police and tell them where the animal is and what it looks like. They will check and quarantine the animal usually for 10 days. If the animal is not infected at the end of the quarantine, he will be released to his owner, and you will be informed that he was found to be non-rabid. However, if the animal is found to be rabid, then you will be in need of shots and required to receive them for protection from the virus.

3. Poisonous Plants. Each summer and fall, many people suffer intense discomfort because of common offenders: poison-ivy, poison-oak, and poison-sumac. Other poisonous plants are the primrose, smartweed, nettle, and cowhage.

Keep plants like the oleander bush, poinsetta, hyacinth, narcissus, daffodil, rosary pea, castor bean, and mistletoe--all seen frequently in homes--out of your child's reach. Just one leaf or seed might kill them. The vines and foliage of tomato, and potato plants contain alkaloid poisons that can cause severe digestive upsets and nervous disorders.

A sensitive individual does not always have to have contact with a poisonous plant because toxic sap smears stick to shoes, tools, pets, and automobile tires or reach the unwary victim through smoke if the leaves, roots, and stalks, are being burned.

There are a large number of plants, weeds, and trees that are dangerous to humans. Refer to the following list. Never put leaves, twigs, seeds, or berries in your mouth unless you are positive they are harmless. These plants may be harmful to you, your children, livestock, or to your pets, if they are improperly handled or eaten. Toxicity for man and animal may vary. Further information may be obtained by writing the New Mexico Pharmaceutical Association, 4800 Zuni SE, Albuquerque, New Mexico, or by calling 265-8729.

TREES AND SHRUBS

Plant	Toxic Part	Symptoms
Wild and cultivated cherries	Twigs, Foliage	Fatal. Contains a compound that releases cyanide when eaten. Gasping, excitement, and prostration are common symptoms that often appear within minutes.

Plant	Toxic Part	Symptoms
Oaks	Foliage, Acorns	Affects kidneys gradually. Symptoms appear only after several days or weeks. Takes a large amount for poisoning. Children should not be allowed to chew on acorns.
Elderberry	Shoots, Leaves, Bark	Children have been poisoned by using pieces of the pithy stems for blowguns. Nausea and digestive upset.
Black Locust	Bark, sprouts, foliage	Children have suffered nausea, weakness and depression after chewing the bark and seeds.
PLANTS IN WOODED AREAS		
Jack-in-the-pulpit	All parts, especially roots	Like dumb cane, contains small needle-like crystals of calcium oxalate that cause intense irritation and burning of the mouth and tongue.
Moonseed	Berries	Blue, purple color, resembling wild grapes. Contains a single seed. (True wild grapes contain several small seeds.) May be fatal.
Mayapple	Apple, foliage, roots	Contains at least 16 active toxic principles, primarily in the roots. Children often eat the apple with no ill effects, but several apples may cause diarrhea.
PLANTS IN FIELDS		
Buttercups	All parts	Irritant juices may severely injure the digestive system.
Nightshade	All parts, especially the unripe berry	Fatal. Intense digestive disturbances and nervous symptoms.
Poison hemlock	All parts	Fatal. Resembles a large wild carrot. Used in ancient Greece to kill condemned prisoners.
Jimson Weed (thorn apple)	All parts	Abnormal thirst, distorted sight, delirium, incoherence and coma. Common cause of poisoning. Has proved fatal.

4. BLINDING DUST STORMS. Blinding dust is to the Southwest as swirling snow is to the colder parts of the nation. Both can be deadly to persons or motorists caught in their seemingly impenetrable masses.

Tactical training may be conducted during light sand storms with adequate safety precautions. Remember that control, maneuver, and large scale movements will be difficult, and that vehicles moving downwind may be further blinded by their own dust. In addition, sand storms will provide an obstacle that will cause difficulties in maintaining direction, especially since there are no roads in the desert. Generally, ground visibility is less than 100 meters.

Personnel driving in wide open areas owe it to themselves and to others to take all possible precautions during blinding sand storms. The following actions should be taken by persons who are caught in dust storms.

a. Pull over to the far right side of roadway, if a dust cloud unexpectedly swirls across the road shutting off visibility. If this happens at night turn off your lights to keep a trailing vehicle from following on a collision course.

b. If the driver and his passengers still believe they are in danger, they should get off their vehicles, move quickly away from the roadway and remain away until the dust clears.

c. Use safety goggles during all movements in sand storms.

5. Hot Weather Precautions. By gradually exposing your skin to the sun--start with a period of only 10 to 15 minutes for the first day and then increase the daily exposure by a few minutes until your skin has a protective tan--you can avoid a serious sunburn, sun poisoning, and even death. At high altitudes, your first exposure should be from 5 to 10 minutes. When the sky is cloudy, you can still get a bad sunburn if you are exposed too long. People with fair skins should be especially careful of sunshine. Skin cancers are sometimes due to prolonged overexposure to the sun's rays.

Heat cramps, heat exhaustion, and heat strokes occur to people who are not accustomed to hot weather, who perspire freely, who are older, and who use excessive amounts of alcohol.

Type of Heat Illness	Symptoms	What To Do
Heat Cramps	Muscle cramps in calf of leg and abdomen. Faintness, dizziness, and exhaustion.	Move to a cool place. Take salt tablets. Drink cool water.
Heat Exhaustion	Weakness, nausea, fatigue, faintness, cold sweat, loss of consciousness. Skin cold and clammy to the touch, pulse weak, and breath shallow.	Move to a cool place, placing person in a slightly reclining position, loosen tight clothing, and get medical aid quickly. Drink a half teaspoon of salt in a half glass of water every 15 minutes for 3 or 4 doses.
Heat Stroke	Cessation of sweating. High body temperature; skin flushed, very dry and hot; face a gray color.	Move to a cool place or shield from sunshine. Sponge body with water or alcohol to bring the temperature down to normal. Get medical aid immediately or get victim to a hospital.
Sunburn	Skin becomes red. Blisters appear, skin swells, often fever and headache develop.	Cold cream or oils or greases as salad oil or shortening may relieve pain. Do not expose injured area to sun until healing is complete.

If you are taking antibiotics, antifungal medicines orally, or some tranquilizers, you may develop a sensitivity to the sun.

During the summer, wear loose, light-colored, and lightweight clothing. Do not overeat. Drink cool water. Use iced drinks in moderation. Avoid overexposure to the sun in the middle of the day. Wear head protection if you must be out in the sun. If you perspire a lot, take salt tablets as directed.

An extra sponge bath for young children will cool them off and help prevent heat rash.

Read the directions on sunburn remedies; some, when used in large quantities, can make the victim even sicker.

If you have pets, provide adequate shade and fresh water.

6. Flash-Floods. Do not camp in dry river beds. When it is evident that rain is falling in the mountains, be ready to get out quickly if walking in them. Runoff from the mountains frequently creates "flash floods" that can sweep an unwary person away. They can also cause vehicle operators trouble as they frequently flood over roadways and upon topping a hill a driver is suddenly confronted by a lake of water in the road.

7. Bubonic Plague. New Mexico holds distinction of being number one nationwide in the incidence of this disease. Each year about 10-20 cases are reported, often with 1 to 3 deaths.

a. The carrier is a normal flea that inhabits rodents and similar wild animals. Thus, pets or children or hunters of these animals may receive flea bites and contract the disease.

b. Symptoms are somewhat similar to a virus infection and progress to fever and nausea. Medical advice must be sought, explaining the possibility of animal flea contact.

c. Prevention is accomplished by bathing and dusting pets, discouraging children from playing with rodents, etc. Bathing and watching for fleas or flea bites is advised.

C O P Y

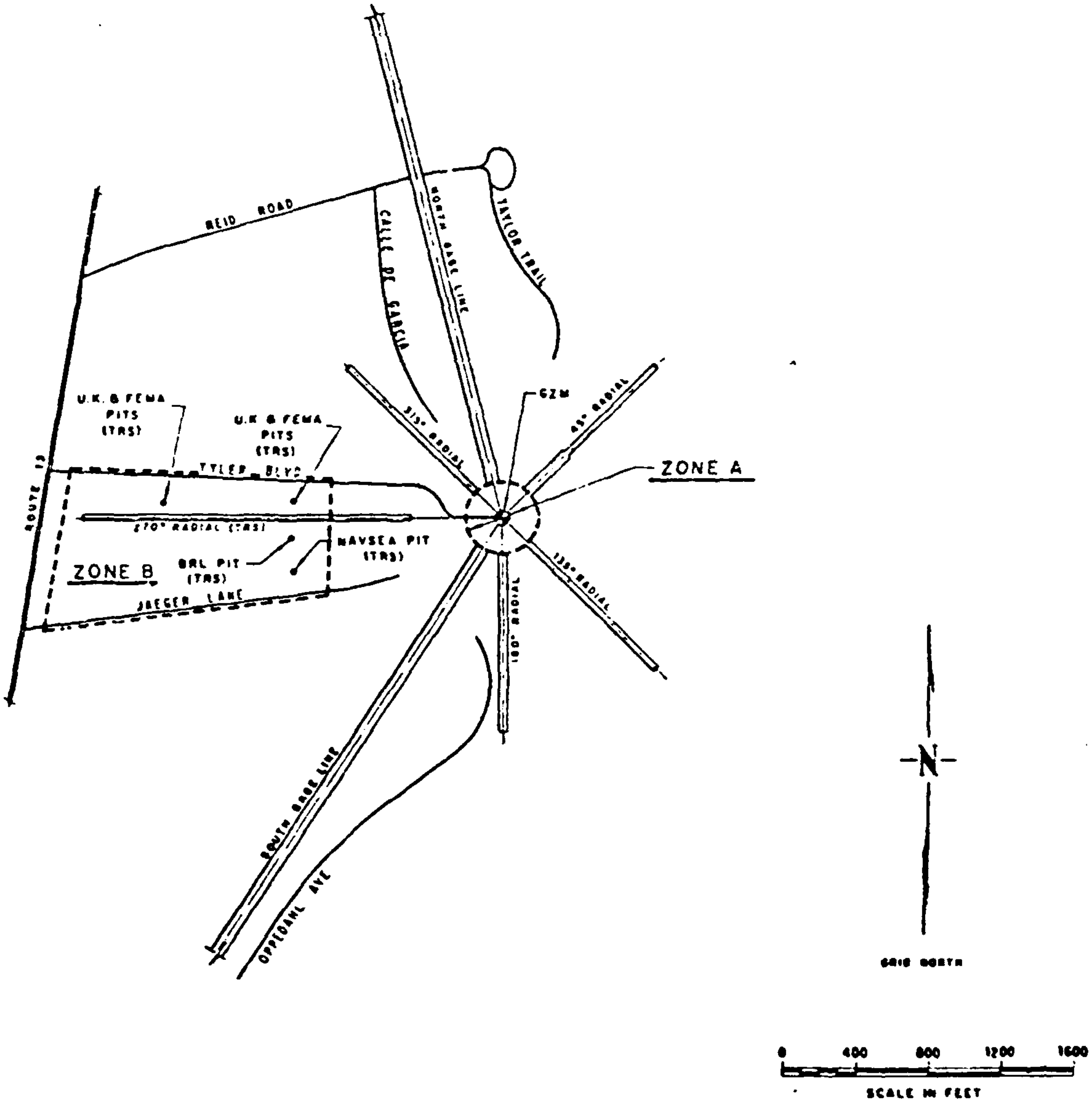

Figure 1. Access restrictions, zones A & B.

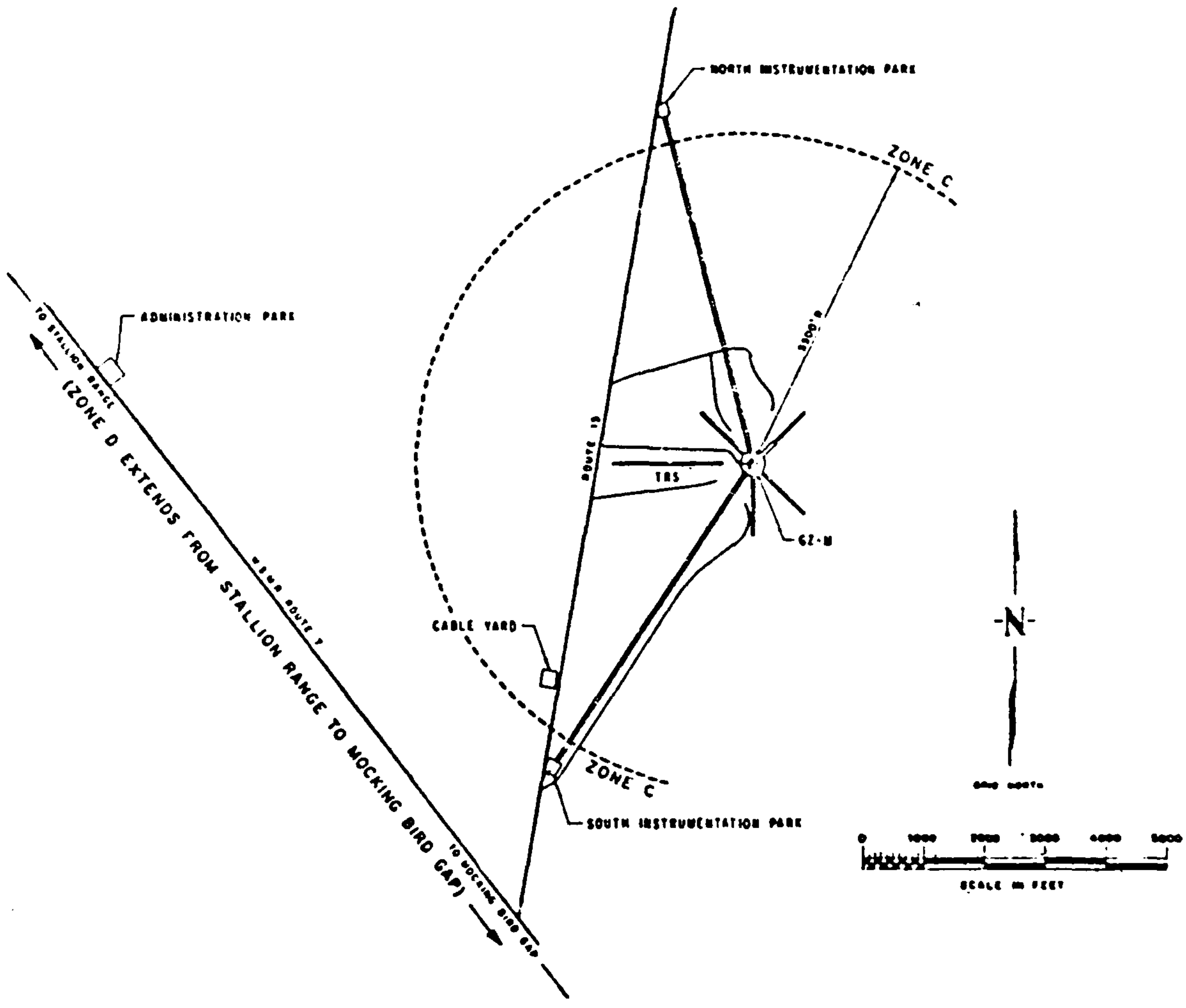

Figure 2. Access restrictions, zones C & D.

APPENDIX E

SUMMARY OF ACTIVITIES
and
ACCESS RESTRICTION

Operation and/or Time	Zone A	Zone B	Zone C	Zone D
Stacking	3	1	1	1
LOX Transfer	1	3	1	1
Prearming	1	1	3	1
Arming	1	1	3	1
Detonation	Access Not Permitted	2	2	3
Postshot	3	3	3	1
T + 30 Minutes	3	3	2	1
T + 2 Hours	1	1	1	1

Restriction Definitions:

1 - No Restriction

2 - Controlled Access

3 - Limited Access

No. ___________

Date. ___________

APPENDIX C-4

Field Command, Defense Nuclear Agency
MILL RACE Program
White Sands Missile Range, New Mexico 88002

Standing Operating Procedure
for
Explosive Operations for MILL RACE

Revision No: 0
Operation No: Main Booster Assembly (MBA) Emplacement & Main Charge Construction
Area: MILL RACE Test Site, WSMR
Explosive Limits: 600 Tons ANFO, 210 lbs Octol
Personnel Limits Per Shift: 16 Operators: 12 Casuals: 4

NOTES:

1. If a condition arises which is not covered by this SOP, the Stacking Supervisor, Test Group Director, MILL RACE Safety Officer, and any personnel designated by the Test Group Director shall confer and devise the safest feasible solution.

2. The ANFO required for the operation will be delivered to WSMR by a vendor and inspected in accordance with appropriate regulations. The ANFO will be delivered to the test site in vendor provided van-trailers and parked in the designated explosive parking area at the test bed.

3. It may be necessary to completely unload a trailer at the GZ before beginning the stacking operations due to demurrage on the shipment.

4. The ANFO will be packaged in 50 pound plastic lined paper bags.

5. The MILL RACE Security Officer will be notified upon delivery of the explosives to the test site so that a security patrol may be established and guard post mounted.

6. Access onto the charge will be by wooden ladder. Standing or walking on the perimeter of the stack will be held to a minimum.

7. Characterization of the explosive charge will be carried out by monitoring the sequence of events in the detonation of the ANFO stack. Seven polished aluminum pipes with lucite diffusers will be embedded in the stack in accordance with the applicable plan. Test gauges require no external voltage.

8. A dry run of the firing and instrumentation systems will be conducted prior to commencing main booster emplacement.

9. The inert MBA shell and inert Booster-Initiation System (BIS) will be fabricated at the Naval Surface Weapons Center (NSWC). It will be shipped by commercial carrier to the MILL RACE test site.

10. The octol explosives will be shipped to WSMR for storage until required at the MILL RACE test site. The octol explosive will be inspected in accordance with appropriate regulations and held in an explosive storage area approved by the Test Group Director until needed for placement.

11. When needed the octol explosive will be transported to the MILL RACE test site in an approved vehicle. The octol will be stored in a secure container located in the designated explosive parking area on the test bed.

12. Wood frame shell systems will be assembled at GZ in sections, each section approximately 4 feet in height. The wood frame shell systems will act as a form for the main explosive charges and provide protection to the stack.

<u>STEPS:</u>

1. Assure that Ground Zero (GZ) Area is prepared according to applicable design drawings.

2. Position first explosives-loaded trailer at the GZ as directed by the Stacking Supervisor. If circumstances require unloading before the stacking operation begins, use the conveyor and position the ANFO as directed by the Stacking Supervisor.

3. Move the MBA shell and inert BIS into the GZ for assembly.

4. Attach the lifting sling to the inert BIS.

5. Insert the inert BIS into the MBA shell and set on end at the GZ.

6. The inert BIS will be used only for structural support during the building of the main explosive charge.

7. Assemble the wood frame shell system at the GZ in accordance with the applicable plan.

8. Insert bottom (first) octol booster into position.

9. Remove the bags of ANFO from the van and pass them on to the stacking crew (carry by hand, one bag at a time, or use the conveyor).

10. Stack the bags of ANFO to form the charge according to the applicable stacking plan.

NOTE: The charge is stacked around the Main Booster Assembly (MBA) shell which was previously emplaced (step 3).

11. Apply adhesive to the bags in accordance with the stacking plan to increase the friction between bags.

12. The bags of ANFO will be spot weighed before placing them into the charge.

NOTE: Damaged (open) bags of ANFO will be set aside. The ANFO in these bags will be visually inspected for fuel oil content. If the ANFO is in satisfactory condition it shall be used for bulk loading. If unsatisfactory the ANFO will be placed in an appropriate holding area for disposal.

13. Open bags of ANFO. Pour the ANFO into the voids between bags as required and level.

14. Place empty bags on the residue vehicle and haul them to the designated sanitary fill site.

15. When the charge has reached the height of the next octol booster, all stacking of ANFO shall be stopped.

16. NSWC personnel shall insert octol booster and lock into position (place fiberglass tape around the circumference and cement upper flange into place).

17. Resume stacking.

18. Repeat steps 15, 16, and 17 for each booster.

19. Move the explosive van-trailer from the GZ when it is empty and move a full van into place.

20. When stacking operations have been completed the canvas roof system will be used to cover the stack cap and at other times when directed by the Stacking Supervisor.

21. Dismantle the wood frame shell system and remove the canvas roof system from the explosive stack according to the applicable countdown.

22. Remove all residue from the GZ area.

INSPECTION REQUIREMENTS:

1. Insure that only the personnel required for this operation are present.

2. Insure area is free of fire hazards prior to commencement of this operation.

3. Explosive hauling/handling vehicles will be inspected daily, before first use.

4. Conveyor will be inspected daily, before first use, for serviceability.

SAFETY REQUIREMENTS:

1. Personnel performing any part of this operation will be thoroughly familiar with the provisions of this SOP.

2. No smoking will be permitted within 100 feet of any explosive or explosive residue. Personnel will leave any flame-producing devices at the container provided.

3. Vehicles used for the transportation and storage of explosives will be appropriately equipped with explosive signs, fire symbols and fire extinguishers.

4. Personnel will wash hands before eating or smoking.

5. Appropriate fire symbols and explosive signs will be posted on access roads around the test area at an appropriate distance to be determined by the MILL RACE Safety Officer.

6. In case of high winds with blowing sand, impending electrical storms within 5 miles, or an indication in excess of 1500v/m^2 on the potential gradient meter, cease operations and evacuate personnel to the control point.

7. An area around the stacking site, 100 feet in radius, will be established and access controlled. Normally, only those personnel required for the operation will be given access to the stacking site by the Stacking Supervisor; however, the Stacking Supervisor may make exceptions. During stacking and non-stacking hours, site operation personnel will control access to the area adjacent to the stack.

8. Fire extinguishers approved by the MILL RACE Safety Officer will be located in close proximity to this operation.

9. Dust respirators will be available at GZ during the construction of the charge.

10. Stacking will be done from the ground, and the stack.

11. Adequate personnel protection will be provided all personnel working at the stacking site, i.e., hard hats, gloves, safety shoes, and face shields or safety glasses.

12. Assure that conveyors and generator are grounded and that generator is placed 60 feet or more from the exposed explosives.

13. Only those vehicles required for transporting explosives will be permitted in the explosive stacking area.

14. The van containing the BIS will be located a minimum of 250 feet from this operation.

15. The wood frame shell system will also provide protection to the ANFO stack from the weather. The structure will be dismantled before event execution.

16. Non-explosive proof enterior lighting, if required, will be positioned 60 feet or more from explosives.

DISPOSITION OF COMPONENTS AND MATERIALS:

1. Empty bags, wrappers, or other material considered to be contaminated with explosives will be disposed of in accordance with appropriate regulations.

EQUIPMENT REQUIREMENTS:

1. Charge wood frame shell.

2. Explosive signs and fire symbols as required.

3. Vehicle equipped with fire extinguishers, explosive signs, and fire symbols for transportation and storage.

4. Potential gradient meter.

5. Box for matches and lighters.

6. Dust respirators.

7. Approved fire extinguishers -- 2 each.

8. Adhesive.

9. Brushes.

10. Plastic sheets.

11. Brooms.

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LEE MEADOWS
NR Program Engineer

No. ____________

Date ____________

APPENDIX C-5

Field Command, Defense Nuclear Agency
MILL RACE Program
White Sands Missile Range, New Mexico 88002

Standing Operating Procedure
for
Explosive Operations for MILL RACE

REVISION NO: 0

OPERATION NO: Pre-arming (BIS) Emplacement, Arming (Firing System Hook-up), and Detonation

AREA: MILL RACE Test Site, WSMR

DNA (b)(3)

[redacted]

PERSONNEL LIMITS: 13 OPERATORS: 9 CASUALS: 4

NOTES:

1. The hazard radius for this test for personnel in the open is considered to be 7,500 feet. Road blocks will be established as determined by the FCDNA TGD. Where appropriate, approach trails will have warning signs. Road blocks will be set in accordance with the countdown check list.

2. Prior to initiation of step 8 under this SOP, the Chief, Arming Party will determine that the test bed is clear of all unauthorized personnel. All personnel will be required to check out through a control point enroute to an Observation Point. Exceptions: Those personnel vital to the test will be allowed in the Timing and Firing (T&F) and Instrumentation vans during detonation.

3. The EBW detonators required for this operation will be stored at an approved location until required for use.

4. A dry run of the firing, instrumentation and camera systems will be conducted prior to commencing this operation.

5. Approval to proceed with this operation must be given by the FCDNA Test Group Director.

6. No radio transmission will be made within 100' of detonator cables or armed charge.

STEPS:

PRE-ARMING

1. The Chief of the Arming Party will check the firing system control unit inside the T&F Van to insure a safe system. All lights on firing panel unit must be OFF: the enable key switch (power switch) must be off and meters must read zero.

2. Remove enable switch key. Key will be in possession of arming party chief.

3. Disconnect the voltage charge lines from the firing system control unit.

4. Lock cable termination resulting from step 3 in lock box. The key will be in possession of arming party chief.

5. At the direction of the Chief of the Arming Party, the arming party will proceed to the BIS holding area.

6. Move the BIS no closer than 200 feet to the GZ.

7. The arming party will proceed to install the field X-unit located approximately 100 feet from the explosive charge. The field X-unit will be safed prior to conducting the following steps.

8. The arming party will request permission from the FCDNA TGD to prepare for pre-arming the explosive stack after insuring the GZ area is clear.

9. The FCDNA TGD will give permission to prepare for the pre-arming of the charge.

10. Remove the shorts from the BIS harness lines and check the cables for continuity with a blasting galvanometer. (This step will be conducted at least 200 feet from the main charge.)

11. The firing cables will be reshorted.

12. The inert BIS will be removed from the explosive charge.

13. The inert BIS will be carried to the arming party vehicle for subsequent removal from the test bed.

14. Position the BIS near the explosive charge.

15. Lift the BIS above the charge and lower into the explosive charge to a point where the BIS is out of alignment with the MBA as previously marked.

16. Peg the BIS onto the MBA using a brass peg through the lift point.

17. The crane will be detached from the BIS lifting assembly. The lifting assembly will be taped to the MBA.

18. The crane will depart the GZ area; the cherry picker will remain in position.

19. The arming party will request permission to complete pre-arming the explosive charge from the FCDNA TGD after insuring that the GZ is still clear.

20. The FCDNA TGD will give permission for pre-armed completion of the charge in accordance with the approved countdown.

21. The arming party will remove the shorts from the firing cables and recheck them for continuity with a blasting galvanometer.

22. The arming party will reverify with a blasting galvanometer that the firing circuit is still in a shorted condition.

23. Remove brass peg and lower BIS into position by hand.

24. Cherry picker will depart GZ area, and two (2) BIS technicians and the photographer will depart for the observation point.

25. The arming party will request permission to arm the explosive charge from the FCDNA TGD after insuring that the GZ is still clear.

26. The FCDNA TGD will give permission for arming of the charge in accordance with the approved countdown.

27. Remove the shorts from the firing cables and connect the cables to the outputs of the field X-unit.

28. The field X-unit will be checked with a VOM to insure no voltage is present prior to connecting the detonator cables. Remove shorting plugs and connect cables.

29. The arming party will notify the T&F Van and Test Control upon completion of arming.

30. The arming party departs GZ to the T&F Van.

31. The Chief of the Arming Party will remain at the T&F Van to operate firing system control unit; personnel not required will proceed to the nearest Observation Point.

32. The Chief of the Arming Party will verify, with the FCDNA TGD that the test is still go.

33. When verification is received the SNLA, Chief of the Arming Party will ready the firing panel.

34. The SNLA Chief will reconnect the high voltage charge lines and install the key in the enable key switch.

35. The SNLA Chief will request the FCDNA TGD to insure that the area is still clear.

36. FCDNA TGD reports area status to SNLA Chief.

37. If status is clear, the countdown sequence will continue. The firing panel will be armed at the appropriate time in the sequence for firing. In event of a misfire, go to step 40.

38. After detonation the firing panel will be secured as in steps 1 thru 4.

39. The arming party (min 2, max 4) will re-assemble at the T&F Van and proceed to GZ to inspect the area for explosives.

40. When the area is determined to be clear of explosives the site will be opened to project personnel.

41. Road blocks will be released as appropriate.

42. In the event of a mission cancellation or re-scheduling, the Arming Party, in order to disarm the ANFO stack, will perform steps 1 thru 4 and reverse step 23.

43. In the event of a misfire the following steps will be performed:

(a) The firing panel will be safed as in steps 1 thru 4.

(b) If the firing system did not dump, as indicated by no movement of the HV Monitor Meter, the arming party may proceed to GZ. If a dump occurred, a 30 minute wait is required before entering GZ.

(c) After the cause of the misfire has been determined and corrected, the test can be restarted at step 25 after the cameras have been reloaded.

INSPECTION REQUIREMENTS:

1. Prior to arming and detonation the area will be visually surveyed to insure that the area is clear.

2. Insure that the detonation site is free of fire hazards prior to commencement of this operation.

3. Insure that the firing control panel is in a safe condition and is not disturbed while the arming party is at GZ.

4. Insure that all hoisting and lifting equipment is in proper condition prior to commencing this operation.

SAFETY REQUIREMENTS:

1. Personnel performing any part of this operation will be thoroughly familiar with provisions of this and the basic Safety Plan for MILL RACE.

2. Make continuity and stray current checks with a blasting galvanometer or approved meter.

3. In case of high winds with blowing sand, an impending electrical storm within 5 miles, or an indication in excess of 1500 V/m on the potential gradient meter, cease operations, and evacuate personnel to the Control Point.

4. No smoking will be permitted within 100 feet of any explosives or explosive residue.

5. Vehicles used for transportation and storage of explosives will be appropriately equipped with explosive signs, fire symbols, and fire extinguishers.

6. Personnel will wash hands before eating or smoking.

7. Only those personnel required for the operation will be given access to the GZ area.

8. The hazard radius for this test for personnel in the open is 7,500 feet.

9. All personnel will be required to check in and out of established road blocks in accordance with the approved countdown. Only those personnel vital to the test will be allowed in manned stations during detonation; all others must evacuate the test bed.

10. No radio transmission will be made within 100 feet of the firing cables, BIS, or armed charge after this operation begins.

DISPOSITION OF COMPONENTS AND MATERIALS:

Any explosive residue found after detonation will be disposed of in accordance with appropriate regulations.

EQUIPMENT REQUIREMENTS:

1. Firing System Control Unit.

2. Field X-units.

3. Firing cables and shorting plugs.

4. Blasting galvanometer.

5. Potential Gradient Meter.

6. Vehicle equipped with fire extinguisher, explosives signs and fire symbols as required by operations.

7. Crane.

8. Cherry picker.

9. Lifting assembly.

10. Guide straps.

11. Brass peg.

12. Electrical tape.

13. Radio.

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Lee Meadows
NR PROGRAM ENGINEER

No. ____________

Date. ____________

APPENDIX C-6

Field Command, Defense Nuclear Agency
MILL RACE Program
White Sands Missile Range, New Mexico 88002

Standing Operating Procedure
for
Explosive Operations for MILL RACE

Revision No: 0
Operation No: Final Assembly of Booster-Initiation System (BIS)
Area: MILL RACE Test Site, WSMR
Explosive Limits: 7 TC 234 Detonators, 14 lbs Pentolite
Personnel Limits: 9 Operators: 6 Casuals: 3

NOTES:

1. Preliminary assembly of the BIS will be made at the Naval Surface Weapons Center (NSWC). The preliminary assembly, without detonators or explosive, will be shipped by commercial carrier to the MILL RACE test site at WSMR.

2. Upon arrival at the MILL RACE test site the inert BIS components will be inspected and stored until needed for final assembly.

3. Upon arrival at WSMR the pentolite initiators will be stored in an explosive magazine until needed for final assembly.

4. When needed, the pentolite initiators will be transported from WSMR storage to the test site in an approved vehicle. The pentolite will be stored in a secure van and located in the designated explosive parking area on the test bed.

5. Assembly of the BIS will be accomplished in a van-trailer located on the test bed. The van-trailer will be located no closer than 160 feet from any hazardous/explosive operation that is being conducted or personnel activity.

6. All adhesives coming in contact with explosives will be an NSWC developed compatible material: R-45M, DDI blend.

7. If a condition arises which is not covered by this SOP, the FCDNA Test Group Director (TGD), NSWC Project Officer, and any personnel designated by the FCDNA TGD shall confer and devise the safest feasible solution.

STEPS:

1. Transport the inert BIS components to the van-trailer for assembly.

2. Inspect and open the box containing the pentolite.

3. Inspect each individual pentolite initiator.

4. Assemble the two sections of the BIS and cement with PVC cement.

5. Check each section of the BIS cable assembly for continuity using an appropriate meter.

6. Prior to installation of the TC 234 detonators, attach the test cable to a detonator and place the detonator beneath a sand filled sandbag.

7. Check the detonator for continuity using an approved blasting galvanometer. Do not perform this operation in the immediate vicinity of the pentolite.

8. Repeat steps 6 and 7 for each of the 7 detonators.

9. Place a detonator into its adapter nut and screw the adapter nut into the flange.

10. Repeat step 9 for all detonators.

11. Insert the pentolite initiators into the BIS, and peg into place with wooden dowels.

12. Insert the shorted cable assembly harnesses (two) and attach to each of the appropriate detonators.

13. After all detonators are in place, remove the cable assembly harness shorting plugs and check the continuity of the completed BIS cable assembly harnesses using an approved blasting galvanometer.

14. Reshort the BIS cable assembly harnesses.

15. Tape the access ports into place.

16. Place the BIS assembly in the approved storage area.

17. Prior to event day, reverify the continuity of the BIS cable assembly harnesses.

18. Reshort the BIS cable assembly harnesses.

19. Seal the access ports.

20. Replace the completed BIS assembly in the approved storage area on the test bed.

INSPECTION REQUIREMENTS:

1. Insure area is free of fire hazards prior to commencement of this operation.

2. Inspect the BIS pentolite initiators and IC 234 detonators for any hazardous conditions prior to commencing this operation.

SAFETY REQUIREMENTS:

1. Personnel performing any part of this operation will be thoroughly familiar with provisions of this and the basic SOP.

2. No smoking will be permitted within 100 feet of any explosive or explosive residue. Personnel will leave any flame-producing devices at the container provided.

3. Vehicles used for the transportation and storage of explosives will be appropriately equipped with explosive signs, fire symbols, and fire extinguishers.

4. Personnel will wash hands before eating or smoking.

5. Insure area is free of fire hazards prior to commencement of this operation.

6. Access to the explosive assembly site will be controlled. Only those personnel required by the operation will be given access to the area.

7. Approved fire extinguishers will be located in close proximity to this operation.

8. No radio transmissions will be made within 100 feet of the van-trailer after this operation begins.

DISPOSITION OF COMPONENTS AND MATERIALS:

Crating materials, wrappers, excess explosives or other material considered to be contaminated with explosives will be disposed of in accordance with appropriate regulations.

EQUIPMENT REQUIRED:

1. Explosive signs and fire symbols as required.
2. Box for matches and lighters.
3. Blasting galvanometer.
4. Fire extinguishers - 2 each.
5. Dupont M101 Blaster's Multimeter.
6. PVC Cement.
7. Adhesive (R-45M, DDI blend).

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APPENDIX D

SECURITY PLANS

D-1. FCTOH Security Plan for HE Tests

D-2. Supplementary Security Plan

APPENDIX D-1

FCTOH Security Plan for HE Tests

1. PURPOSE

The purpose of this document is to consolidate those policies, responsibilities and procedures that are common to all DNA non-nuclear above ground high explosive tests and to provide a means for implementing specific security procedures unique to these HE tests.

2. SCOPE

This document is applicable to all DOD FCDNA and DOD/FCDNA sponsored participating agencies and all other contractors directly and/or indirectly supporting DOD/FCDNA activities. The test site defined for the DOD/FCDNA events includes administrative, operational, and explosive areas.

a. Administrative Area. That part of the test site that includes the test control, observation, and logistic support areas.

b. Operational Area. That part of the test site that includes the technical operation functions, instrumentation parks, and the test bed.

c. Explosives Area. The area within the test bed where explosive charges are emplaced and detonated, and the area used for explosive storage and disposal.

3. APPLICATION

This document is applicable to all high explosive tests, regardless of test location. All participating organizations will comply with the policies contained herein. The Test Group Director (TGD) may permit variance if, in his judgment, the test cannot be otherwise accomplished. In such cases, adequate alternate security procedures will be established, approved, and published. When a conflict exists between the requirements of this document and other instructions or procedures, the procedures providing the most stringent or highest degree of protection will be followed. Mandatory security requirements are indicated by the use of "will" or "shall."

4. RESPONSIBILITIES

a. Field Command, Defense Nuclear Agency (FCDNA):

(1) The Test Group Director (TGD) is assigned the total security coordination responsibility for the DOD/FCDNA sponsored participating agencies, and all other contractors for the events. In particular, the TGD will:

(a) Develop a security plan.

(b) Designate a Test Group Security Officer.

(c) Take necessary actions to insure the security of the test site.

(d) Furnish copies of applicable security instructions and regulations to all agencies participating in the event.

(e) Establish a security briefing program for the event.

(2) The Test Group Security Officer (TGSO) is responsible to the TGD for implementing the security program and will be the primary contact on the Test Group Staff (TGS) for all security matters. He will coordinate the security requirements of all participating agencies and will coordinate Test Group security requirements with the responsible station security office. Specifically, the TGSO will:

(a) Provide the TGD with advanced shipping information of sensitive items, and classified materials and materiel.

(b) Administer the security briefing program.

(c) Coordinate and arrange for guard services and write appropriate guard instructions supplying sufficient information for guard orders to be written.

(d) Arrange for repositories for documents and material at the event site.

b. Project Officers (PO) are responsible for the security of classified information, material, and documents under their control and for the security indoctrination of all personnel assigned to their projects at the test site. Project Officers will:

(1) Coordinate their security plans and procedures with the TGSO to insure compliance with the applicable directives and to economize security facilities and services.

(2) Develop specific requirements for the protection and control of classified areas, information, documents, materials, and sensitive items unique to the test.

(3) Designate, in writing, a custodian and alternate custodian who will be responsible for the safeguarding of all classified materials in the custody of the project agency at the event site. A copy of the designation will be provided to the TGSO.

(4) Identify in writing to the TGSO the number and classification of all classified items to be used at the test site. The number of classified documents to be used should be kept to the absolute minimum required to perform the experiment.

(5) Provide the TGSO with advance shipping information of sensitive items, classified materials and materiel.

(6) Will advise the TGSO in advance of all movements of classified hardware to the test site. Under no circumstance will classified hardware be installed at the test site until the TGSO has been notified and necessary security procedures established. Generally, the experiment installation schedule will consider such security requirements.

(7) Provide the TGSO a list of names of all personnel fielding the event, and non-duty hour location(s) and telephone numbers of key supervisory personnel.

(8) Will be responsible for materiel under their cognizance, to insure it is properly secured and protected during non-duty hours.

(9) Establish an internal property control system for agency use to insure materiel is not taken off the test site without agency authorization.

(10) Submit requests for security clearances to responsible security office.

c. Fielding Personnel. Each individual will immediately report any unauthorized visitor(s) or suspicious activities to the Test Group Security Officer (TGSO) or to the security guard, either personally or by radio. Additionally, each individual who has knowledge or custody of classified information or material must apply basic security principles, common sense, and logical interpretation of existing directives to protect that information or material. Any person having knowledge or suspicion of a security violation (an incident which may have resulted in loss or compromise of classified information or material) will immediately notify an officer of the TGS, and take such action as necessary to protect classified material until relieved by appropriate authority. Each individual will familiarize himself primarily through briefings, with policies and procedures to maintain operational security.

5. INSPECTIONS

All offices and trailers which contain classified repositories will be inspected as prescribed by the local security office and locked with an approved lock. Security inspections will be made for all other trailers and offices in which classified material has been or may have been used. All trailers and offices will be locked in order to adequately control and maintain government property. A security guard will make continuous checks and report all areas where government property on the test site is inadequately protected against theft or loss. For all locked trailers, offices, working areas and repositories, the names, addresses and telephone numbers of persons who can provide access to that specific area or who should be notified in case of an emergency, will be prominently posted in accordance with appropriate regulations. Occupants of trailers/vans will be responsible to insure that spaces/facilities are properly secured.

6. USE OF RADIOS

All personnel are reminded that radio nets are subjected to being monitored by unfriendly agents who may gain intelligence not only from what is said, but also from increasing traffic just prior to event time. The radio nets will be used for essential traffic only.

7. CLASSIFIED MATERIAL AND CLASSIFIED MATERIEL ACCOUNTABILITY AND CONTROL

a. General. This plan includes provisions for accountability, control and delegation of authority and responsibilities. This plan and the attendant procedures are applicable to all military and civilian personnel, contractors, official visitors, guests and all others authorized access to the test site.

b. Classified Material Accountability.

(1) The TGSO will maintain responsibility for and accountability of all classified material and classified materiel controlled by FCDNA.

(2) The Agency Project Officers will provide the TGSO a list of all classified materials and documents, the estimated time of arrival and mode of arrival at the test site. The Agency Project Officers will also notify the TGSO at least 24 hours in advance of the scheduled arrival at the test site.

(3) The TGSO will notify the responsible security office of the requirement to establish a classified repository.

(4) The responsible security office will survey (if required), designate a repository location, and instruct the TGSO as to the security regulations and procedures to be followed.

8. SENSITIVE ITEM ACCOUNTABILITY AND CONTROL

a. General. This plan includes provisions for accountability, control and delegation of authority and responsibilities. This plan and the attendant procedures are applicable to all military and civilian personnel, contractors, official visitors, guests and all others authorized access to the test site.

b. Sensitive Item Accountability

(1) The TGD or his representative [Program Director (PD)] will:

(a) Maintain responsibility for and accountability of all sensitive items which are the responsibility of FCDNA.

(b) Record (document) the exact amount and nature of all sensitive items expended in testing, turned over for destruction, and removed from the test site.

(2) The Program Director(s) will coordinate the inspection of all incoming or outgoing shipments with the TGSO and Safety Officer for their respective experiments.

c. Establishment of Controls

(1) At least 48 hours in advance of the requirement, the TGSO will establish and maintain physical security surveillance of sensitive items.

(2) The security force will control the access into the explosives/stacking area to insure that only authorized individuals are allowed. Individuals will be listed on an access list and will not be permitted beyond the control point unless authorized by the TGD or designated Test Group Staff members.

(3) The security force will verify all locks on all storage/shipping vans during entries into the explosive area.

9. PHOTOGRAPHY

a. Technical Photography. A photographic plan of technical camera layout will be required depicting camera orientation, target, field of view, and lens focal length as a minimum. Cameras will be inspected prior to event day, for conformance with the plan.

b. Documentary Photography. When classified items are on the test bed, photographer(s) will be required to coordinate with the TGSO and the Photo Program Director prior to taking photographs.

10. PHYSICAL SECURITY

a. General. This plan and procedures are applicable to all military and civilian personnel, contractors, office visitors, guests and all others authorized access to the test site. This plan delineates responsibilities and establishes procedures for safeguarding government and private property at the test site.

b. Test Site Entry. The test site will have notices or signs posted along the boundaries, forbidding entrance to unauthorized personnel. Accordingly, the following procedures will be utilized to enter the test site.

(1) Working hours. During normal working hours, the test site will be a non-controlled area, except where specifically posted. All visitors shall report to the admin area. All suspicious activities/personnel will be reported to the TGSO or TGD immediately.

(2) Non-working hours. Test site entrance is regulated by security guards (nights, holidays and weekends).

(a) The TGSO will provide a site access authorization list (SAAL) to the security guard. Agency Project Officers are responsible for maintaining current names of their personnel on the SAAL and notifying the TGSO accordingly.

(b) The security guard will permit entrance to the test site of personnel and equipment provided they appear on the SAAL.

(c) Personnel will notify the security guard when departing the area.

c. Test Site Security. All fielding personnel are to insure that doors, windows, and gates to all buildings, areas, vans, or other structures are secured by locking at the end of each workday or at any other time a facility becomes non-operational or is unattended.

11. OPERATIONS SECURITY (OPSEC)

a. General. This plan and the attendant procedures are applicable to all military and civilian personnel, contractors, official visitors, guests and all others authorized access to the test site. This plan delineates responsibilities and establishes procedures for protection of sensitive operations and activities associated with the test site.

b. Establishment of Controls. The TGD or his representative (TGSO) will establish procedures to:

(1) Identify intelligence vulnerabilities which are susceptible to hostile exploitation.

(2) Eliminate or control these intelligence vulnerabilities.

APPENDIX D-2

SUPPLEMENTARY

SECURITY PLAN

JUNE 1981

SUBMITTED BY:

William F. Taylor

WILLIAM F. TAYLOR
LCDR, USN
Security Officer
MILL RACE

APPROVED BY:

Gary H Reid

GARY H. REID
LCDR, CEC, USN
Test Group Director
MILL RACE

MILL RACE SECURITY PLAN

SUPPLEMENT TO

STANDARD SECURITY PLAN FOR FCTOH EVENTS

1. Introduction.

This supplement is intended to provide additional security guidance and plans which are peculiar to the MILL RACE test. This test is planned for execution at White sands Missile Range, N.M.

2. Staff Security Organization.

Test Group Staff security personnel are:

(1) Test Group Director (TGD) - LCDR Reid

(2) Test Group Security Officer (TGSO) - LCDR Taylor

(3) Alternate Test Group Security Officer - CPT Grayson

(4) Document Control Officer - MILL RACE clerk

3. Restricted Areas.

The below listed restricted areas are all located on the test bed:

a. On or about D-16, the explosive area will become a restricted security area. A single 24-hour guard will control access into this area. Access will be limited to TGD cleared personnel.

b. On or about D-15, the area surrounding experiments 2301, 2303, 2303 and 2305 will be restricted. A 24-hour guard force will control access into this area. Access will be limited to TGD and the PO (of these experiments) cleared personnel.

c. On D-1, the entire test bed area will be restricted security area. Access will be limited to TGD cleared personnel.

d. On or about D-180, all instrumentation trailer parks will be a restricted security area. Access will be limited to approved personnel. Requirements for classified containers at the trailer park must be submitted to the TGSO for coordination. During non-working hours, buildings containing repositories will be locked, sealed, and checked by the TGSO.

e. On or about D-120, all project officers (PO) trailers located in the administration area will be a restricted security area. Access will be limited to approved personnel.

f. On or about D-45, the entire test bed area may become a restricted security area. Additional information will be published at a later date.

4. Access to WSMR by Foreign Nationals.

Visit requests must be submitted to the Military Attache of the Embassy concerned in Washington, D. C. by each foreign national participant or visitor. Requests should be forwarded to WSMR Security in sufficient time to allow for administrative processing.

5. Visitor Control and Identification.

WSMR security badges will be issued to all personnel participating in MILL RACE. Notification of impending visit to WSMR to participate in MILL RACE will be forwarded to CG, WSMR, Attn: DP-SI, so as to be received NLT 30 working days prior to expected arrival. Copies of this correspondence should be provided to TGSO to facilitate coordination.

6. Guard Requirements.

Specific guard requirements will be published at a later date.

7. Emergency Telephone Numbers.

Telephone numbers will be published at a later date.

APPENDIX E-1

ENVIRONMENTAL ASSESSMENT OF THE MILL RACE HIGH-EXPLOSIVE FIELD TEST

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November 1980

Environmental Assessment

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Prepared for:

Director
DEFENSE NUCLEAR AGENCY
Washington, D.C. 20305

SUMMARY

This is an Environmental Assessment (EA) for Project MILL RACE, a large-scale, high-explosive (HE) field test proposed by the Defense Nuclear Agency (DNA). The basic purpose of MILL RACE is to expose shelters, military systems, and equipment to blast, shock, and thermal phenomena that simulate those from a nuclear weapon to obtain data needed for the evaluation of the tested items' hardness and our defense capabilities.

The proposed test site is in the northern portion of White Sands Missile Range (WSMR), a National Range in New Mexico. A location on WSMR is preferred because it has adequate space, is near DNA Field Command, has the resources needed to support a large field test, and working relationships have been established from the DICE THROW HE test that was conducted in 1976 near the proposed test site. The particular ground zero location (GZM) is desired because of its geological characteristics.

The MILL RACE Program basically consists of constructing a test bed for the HE charge and experiments, installing the experiments, constructing the charge, constructing four gage lines, building three instrumentation parks and an administration area, and installing temporary roads, utility lines, instrument cables, etc. to support the test. A total of approximately 120 acres of sand grasslands and dunes vegetation association is expected to be denuded by the construction phase, which is expected to begin in January 1981. The explosion of 600 tons of ANFO, which is equivalent to 500 tons of TNT or 1 KT nuclear, is planned for September 1981. Following the test execution, the area will be cleaned up and the excavations filled. Cleanup should be completed by December 1981.

GZM for MILL RACE is approximately 14 miles from the nearest boundaries of WSMR. The area is primarily grassland with good forage characteristics. It is estimated that 250 small mammals (mostly mice and rats), 40 birds, and 1200 to 1800 reptiles (almost entirely whiptail lizards) will lose their habitat from the construction activities and can be expected to die. The Trinity national historical site is a few miles from GZM. An archaeological survey of the proposed test site has been conducted. No significant archaeological sites were found.

The environmental effects of the construction activities do not seem significantly adverse. The disturbed 120 acres of grassland are a small portion of the type of acreage on WSMR. No endangered species will be affected. Humans should not be disturbed in any manner because the nearest range boundary is 14 miles from the site. The town of Socorro will benefit economically to some extent from housing and feeding project personnel.

The only possible significant effects from test execution would be from the explosion phenomena. Ground-level concentrations of air pollutants from the explosion cloud will be well within the most stringent air-quality standards. Animals and vegetation within 3000 feet of GZM might be injured by airblast, but most such destruction will have occurred from the construction activities. Again, no endangered species will be affected. Window damage and excessive noise in civilian population centers is unlikely. Meteorological conditions will be monitored before exploding the charge so that conditions that amplify blast can be detected and avoided. Based on a structural analysis, the historic McDonald Ranch should not be significantly damaged by airblast or ground shock from the MILL RACE explosion. Structures and portions of structures which exist today at the McDonald Ranch survived the Trinity Event and that event had a peak reflected overpressure of about 2.3 psi. The MILL RACE test will generate a peak reflected overpressure of about 0.70 psi. The damage assessment indicates a high probability that no substantial structural damage will occur; however, in some places nonstructural components such as ceiling sheetrock, are very weak and may be damaged. Loose stones which lie on top of some walks may fall. Protective measures are felt to be not necessary, provided that MILL RACE is not executed when meteorological conditions are conducive to ducting of airblast.

There is no reason to expect that the MILL RACE Program will be environmentally controversial.

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SECTION 1

NEED FOR THE PROPOSED ACTION

A continuing need exists for the United States and other NATO nations to test the response of defense systems and equipments when exposed to nuclear weapon explosions. Since aboveground nuclear weapon tests are prohibited, simulators are used to create some aspects of a nuclear weapon detonation; among these are the high-explosive (HE) simulator for producing blast and shock and Thermal Radiation Sources (TRSs) that burn fuel at very high temperatures to produce thermal radiation. Material samples, scale models, equipment components, etc. can be tested in small-scale tests, but to test full-sized large systems it is necessary to conduct a large-scale field test, requiring large amounts of high-explosives to produce the required magnitudes of blast and shock over substantial land areas.

The last large HE field test that tested large numbers of equipments was DICE THROW in 1976. Twenty-nine military commands, government agencies, and Department of Defense (DOD) contractors, and six other NATO nations participated in DICE THROW. The Defense Nuclear Agency (DNA) has received numerous requests to conduct a program of the magnitude of DICE THROW to test new and improved systems and concepts and to increase the data base for systems that have been previously tested. In particular, it is desired to expose many of the test items to combined blast and thermal radiation phenomena to evaluate the synergistic effects of these phenomena.

The Defense Nuclear Agency of the Department of Defense proposes to conduct the MILL RACE high-explosive field test program to provide empirical data on the response of military systems and equipments and buried structures to simulated nuclear airblast, thermal radiation, and ground shock. Such data can be used to analyze and improve our military and civil defense capabilities.

SECTION 2

ALTERNATIVES CONSIDERED

This section is organized as follows:

- The proposed MILL RACE Program and its alternatives are described
- The existing environment at the proposed test site is described and the reasons for preferring this site are given.

PROPOSED PROGRAM AND ALTERNATIVES

For MILL RACE it is tentatively planned to detonate a charge of explosives equivalent to 500 tons of TNT, which will simulate the blast and shock from a 1-KT nuclear surface burst. Numerous agencies of the United States and other NATO nations plan to field experiments exposing tactical and strategic weapon systems, communication systems, vehicles, aircraft, and structures to the resulting blast and shock. It is also proposed to simulate nuclear weapon thermal radiation for selected experiments in conjunction with blast and shock.

MILL RACE basic objectives are as follows:

1. Record the blast and shock phenomena
2. Record damage to weapons, shelters, and systems
3. Record effects of combined blast and thermal phenomena
4. Increase the weapons effects data base.

The various agencies will have their own specific objectives regarding their individual experiments.

The proposed MILL RACE field test is an alternative to the atmospheric detonation of a nuclear device. It is planned to simulate the blast and, in part, the thermal radiation from a 1-KT nuclear surface weapon burst, without the radioactivity associated with a nuclear weapon. The objectives of the MILL RACE Program have been judged important enough to justify it. If MILL RACE is not conducted, these objectives cannot be met. Reanalysis of existing data and laboratory simulations will not meet the program objectives because empirical data do not exist, or are sparse, for many of the full-sized systems to be tested and for systems exposed to combined blast and thermal radiation phenomena.

Given that a field test is necessary to achieve the program objectives, alternatives to the program as proposed might be to conduct the program at a different location (discussed later in this section) or to modify the scope of the program. The sizes of the HE charge and the thermal sources have been chosen to produce the necessary levels of blast and thermal radiation that are similar to those from a nuclear explosion over areas large enough to accommodate the experiments. If the analysis in this Environmental Assessment (EA) or its review indicates that significant environmental impact might occur from the program as planned, alternatives to mitigate such damage can be considered.

The MILL RACE Program is in its planning stage. A site location has only recently been selected and the test experiments are being defined. A final layout of the test bed and support facilities and details on construction will not be known for some time. Nevertheless, past experience indicates that adequate information is available to prepare an EA for the construction, test execution, and cleanup phases of the MILL RACE Program. MILL RACE is expected to be very similar to the 1976 DICE THROW Program--the locations are near each other, the explosive charge sizes and configurations will be essentially identical, and many of the proposed MILL RACE experiments are similar to those of DICE THROW. Therefore, the DICE THROW Program is being used as a model for MILL RACE, and where specific characteristics of MILL RACE have not yet been determined the experience from DICE THROW, as documented in References 1 and 2, can be applied.

The proposed location for MILL RACE is the northern portion of White Sands Missile Range (WSMR), New Mexico. WSMR is a National Range operated by the U.S. Army primarily to support missile development and test programs. Access to WSMR is restricted, and the proposed test site is approximately 14 miles from the nearest unrestricted area. The unrestricted areas adjacent to the northern WSMR are very sparsely populated. The proposed test site is located in the Jornada del Muerto basin. Climate, vegetation, and animal life are fairly typical of other areas of the Southwest having a similar elevation of approximately 4900 feet. The environment of the proposed test site is described in greater detail later in this section.

The tentative schedule for MILL RACE field activities is as follows:

• Construction Phase	
-- Preparation of the test site	January-March 1981
-- Construction at the test site	April-August 1981
-- Fielding of the experiments	May-September 1981
• Test Execution	September 1981
• Cleanup	October-December 1981.

Construction Phase

The major construction features of the MILL RACE Program will consist of the following:

- A test bed for the HE charge and experiments
- Three instrumentation parks and an administration area

- Three airblast gage lines and one ground motion gage line
- Construction of the HE charge
- Construction and instrumentation of the experiments
- Roads, utility lines, etc. to support the program.

The layout for the test bed has not yet been designed, but it will be defined by the shock levels and land area required by the individual experimenters. However, because the experiments are similar, the test bed should be quite similar to the test bed for DICE THROW shown in Figure 1. As can be seen, virtually all of the DICE THROW experiments were located within 2000 feet of ground zero (GZ) (i.e., the location of the HE charge), and most were located within the 5-psi airblast peak-overpressure range of 1370 feet from GZ. Within these radii, a considerable portion of the land area was not assigned to project purposes. The area assigned to experimenters and allotted for the HE charge shown in Figure 1 totals approximately 100 acres. This amount of land should also be required for MILL RACE because most of the proposed MILL RACE experiments require airblast levels of 5 psi or more, similar to the requirements for DICE THROW.

The area for the MILL RACE HE charge will be cleared of any vegetation and leveled as necessary. The land allotted to the experimenters, and its vegetation, will be disturbed only as necessary to install the experiments and provide a clear field for the explosive airblast and thermal radiation. It is desirable to disturb the vegetation and land as little as possible so as to reduce the problems caused by blowing dust from wind erosion and from the airblast when the charge is exploded.

Additional land will be disturbed for installation of the four airblast and ground-motion gage lines (each approximately 10 feet wide and 6000 feet long) and for access roads. For DICE THROW, a total of 7 miles of 16-ft-wide access roads were required. Thus, based on DICE THROW experience, approximately 15 acres of land can be expected to be disturbed for gage lines and roads. A relatively small amount of land will be disturbed by trenching for any underground installation of instrumentation and power-line cables.

Three instrumentation parks will be located approximately 6000 feet from ground zero of MILL RACE (hereafter referred to as GZM), one near the end of each airblast gage line. An administration area will be built farther away (at a distance of 10,000 feet for DICE THROW). The instrumentation parks and administration area for DICE THROW required approximately 3 acres of land and contained approximately 40 trailers and portable buildings.

In summary, based on DICE THROW experience, a total of approximately 120 acres of land will be allotted for the experiments or required for the HE charge and for access roads, gage lines, instrumentation parks, and the administration area. As a conservative assumption, it will be assumed that all of these acres will be cleared

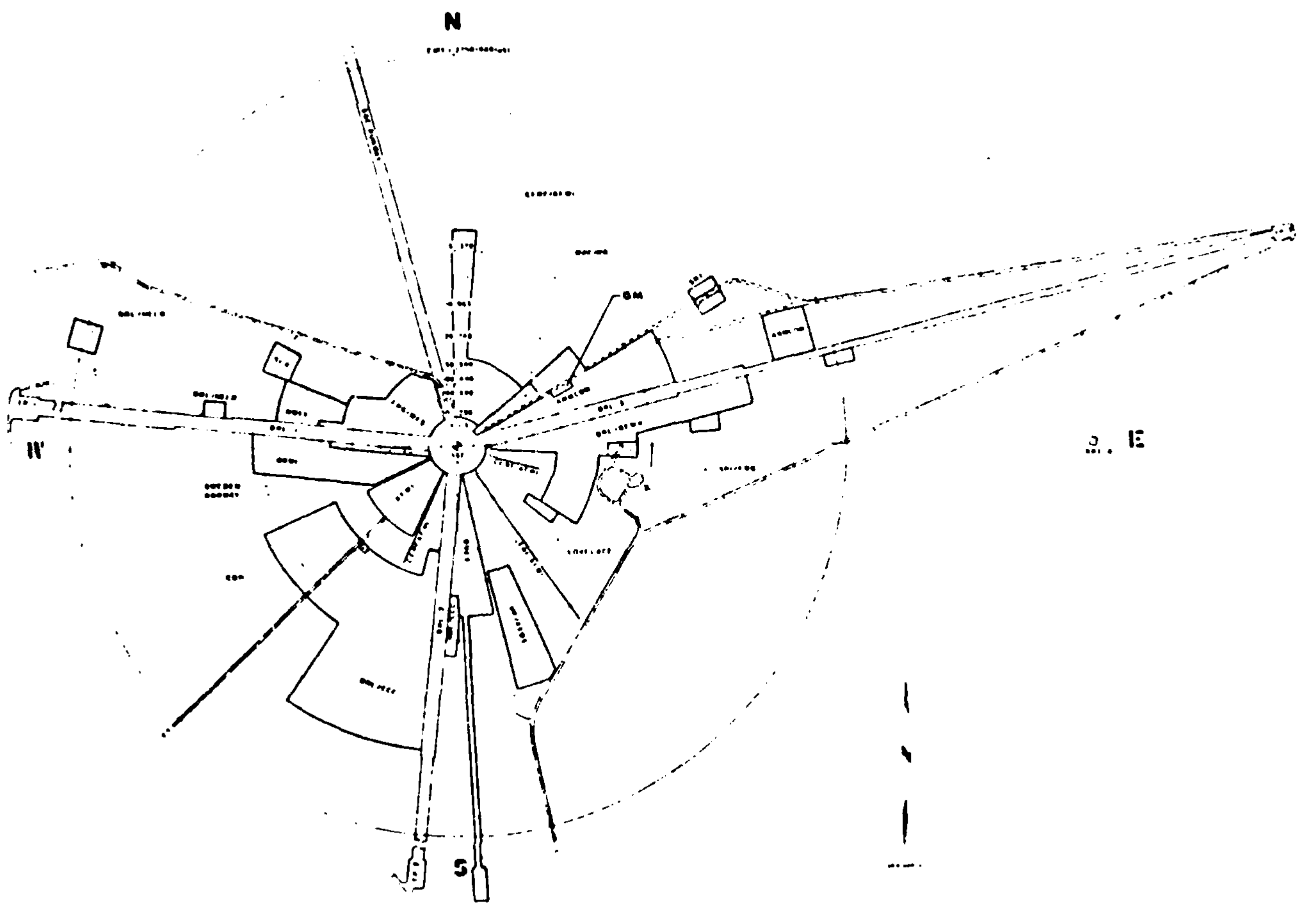

Figure 1. DICE THROW testbed layout. (Source: Reference 1)

of vegetation and the ground surface disturbed; however, in actuality, much of the area allotted to the experiments will not be disturbed. Figure 2 shows an aerial view of the DICE THROW test area the day before the event was executed. (For viewer perspective, the approximately 400-ft radius of continuous crater ejecta that resulted from the explosion is drawn on this photograph.) As can be seen, large portions of the test area were not disturbed by the construction.

The construction activities will be typical of those for large construction projects involving earthmoving, steel, and concrete construction. Based on an examination of the experiments planned, no unusual types of construction activities are foreseen. The typical heavy equipment such as bulldozers, graders, cranes, and trucks will be required. The WSMR Facilities Engineer (FE) will perform most of the construction for the test site and in support of experiments, as was the case for DICE THROW. The availability of the construction work force and equipment at WSMR is a major reason for conducting MILL RACE at WSMR.

[redacted]

DNA
(b)(3)

For DICE THROW, the 7 miles of access roads and the instrumentation parks and administration area were constructed by grading and putting down a layer of gravel. The gravel was obtained from WSMR and was crushed, delivered to the site by truck, and spread. It is expected that the same procedures will be followed for MILL RACE.

Nearly 300 miles of signal and power cable were required for DICE THROW. Underground portions of such cables will be installed by the use of trenching machines and cable-laying equipment; shallow trenches can be cut by the tip of a grader or bulldozer blade.

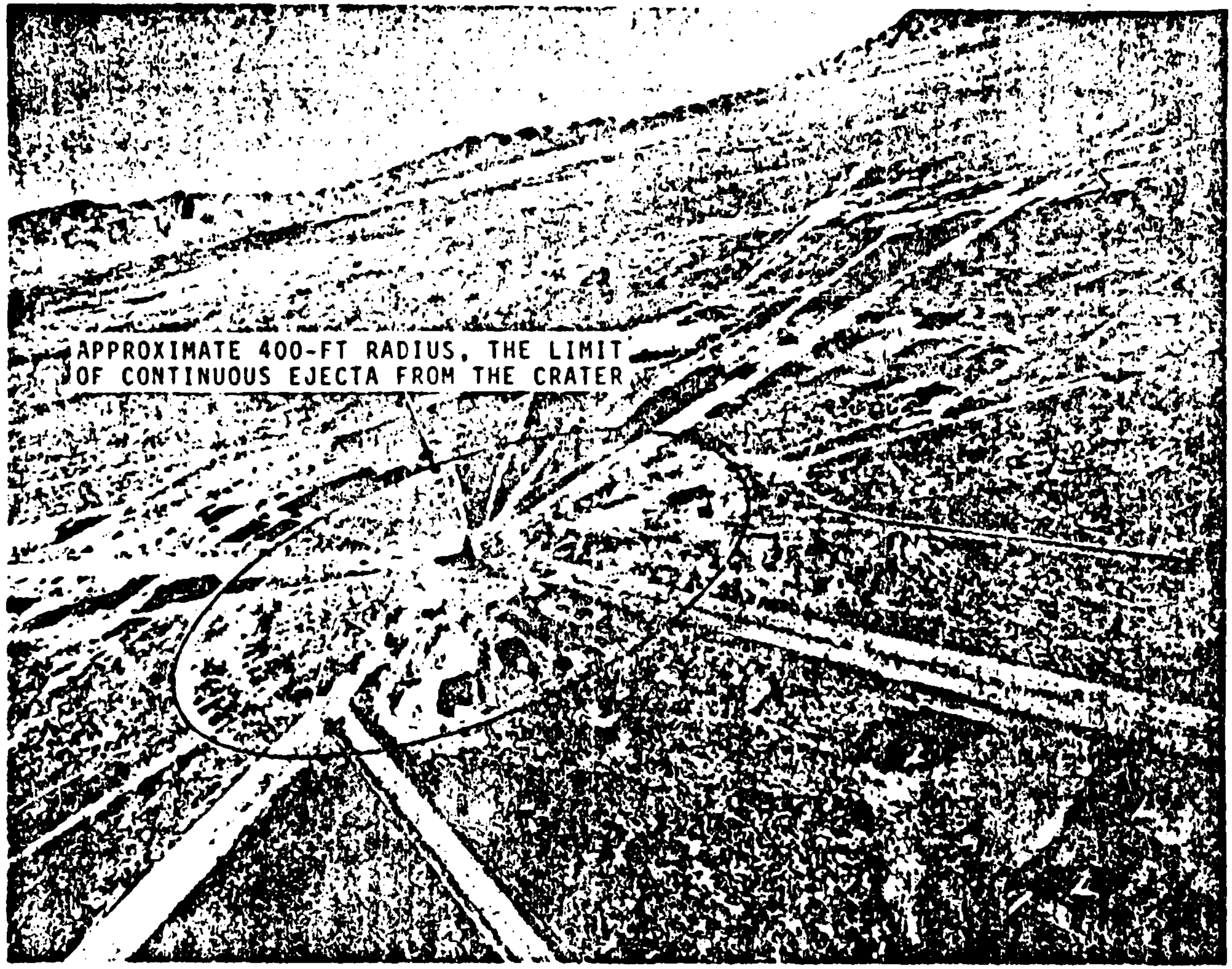

Figure 2. Preshot DICE THROW testbed. Aerial view looking southeast the day before test execution. (Source: Reference 2)

Most of the experiments and sensors will require mounting on concrete pads or footings or on frameworks that are set in concrete. Also, some of the experiments will be installed below grade level or completely buried. Numerous excavations will be required. A concrete batch plant was built at the test site for the 1300 cubic yards of concrete that were placed for DICE THROW.

Water for drinking and construction will be hauled to the site by water truck. Portable chemical toilets will be used onsite. DNA has estimated a staffing requirement for 435 manmonths onsite, with 56 staff members onsite during the approximately 6-month period of construction and test execution. Government agencies and contractors will require additional personnel for the construction of the experiments, installation of instrumentation, and recording of data at the time of execution. Project personnel will be housed offrange, probably in Socorro, the nearest town large enough to have the necessary motel and restaurant facilities. The use of WSMR personnel for most of the construction will reduce the requirement for outside housing of temporary personnel.

Experiments

The MILL RACE experiments, as they are presently conceived (Reference 3), are described in summary fashion in this subsection. They are as follows:

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

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DNA (b)(3)

Most of the above-described test objects will require concrete pads or footings to hold them in place. Instrumentation will consist of active and passive sensors and motion-picture and still photography. The majority of the experiments require airblast peak overpressures of 5 psi or greater, i.e, to be located within 1400 feet of GZM. Land area requirements for experiments beyond 1400 feet from GZM will be modest, consisting of some of the UK antennas, some of the U.S. aboveground buildings, some of the shelter vans, UHF/EHF equipment, and seismic recorders used to measure the explosion phenomena.

Test Execution Phase

It is expected that the MILL RACE charge will be detonated around 11:00 a.m. or noon in September 1981, when preparations are complete and meteorological conditions, as monitored by a meteorological team, are likely to be acceptable. Prior to detonation, weather balloons will be launched periodically to measure wind and temperatures aloft so that long-range airblast levels can be calculated and compared to data on civilian population centers to determine the likelihood of window breakage and excessive noise. Usually, it is not difficult to obtain meteorological conditions that reduce airblast levels in population centers, but if damage is likely to occur the amount can be estimated so the decision can be made whether to detonate the charge or to wait for better meteorological conditions.

It is planned to expose many of the test items to the combined simulated nuclear effects of airblast and thermal radiation. The type of Thermal Radiation Source (TRS) planned for MILL RACE utilizes fine aluminum powder and oxygen. The aluminum powder is fluidized by mixing with nitrogen and is then mixed with oxygen in the throat of a mixing pipe. The mixture is forced from nozzles by the combined pressure of the oxygen and nitrogen where it is ignited by propane gas pilot lights. The aluminum/oxygen mixture burns extremely vigorously (deflagrates) to produce a very hot flame. The air emission from this deflagration is a dust of fine alumina (Al_2O_3), the nitrogen gas carrier, and, as is the case of any high-temperature reaction involving oxygen and nitrogen, oxides of nitrogen.

A TRS is comprised of a line of nozzles spaced about 3.5 feet apart, pointing upward, and mounted to the feeder pipe which is in a trench. It is expected that four to six TRSs, with a total of 40 nozzles, will be needed to produce the required thermal radiation. A typical array of eight nozzles burning for 2 minutes will produce enough heat to ignite coarse grass (6 cal/cm^2) at a broadside distance of 35 feet or to produce first-degree burns to human skin (2 cal/cm^2) at 61 feet.

During the test execution countdown, access to the test site will be closed off, personnel will be withdrawn to safe locations after completing last-minute preparations for their experiments, experiments and measuring systems will be activated, the thermal sources will be ignited to burn for less than a few seconds, the HE charge will be detonated, and the data will be recorded. The most significant project action during the test execution phase will be the phenomena resulting from the HE explosion.

The details on the HE phenomena that could result (using worst-case assumptions) from the detonation of the proposed 600-ton HE charge of ANFO are contained in Appendix A and are summarized below. The effects of these phenomena on the environment are analyzed in Section 3.

The explosion of a large charge of HE on, or near, the ground surface produces shock waves in the air (airblast) and in the ground (ground shock). The magnitudes of these shocks decrease as the shock waves propagate away from the point of detonation. The estimated distances from MILL RACE GZM at which potentially environmentally significant shock magnitudes will occur are tabulated in Table 1.

Airblast peak overpressures greater than 3 psi, which is the approximate threshold of lethality to a small mammal such as a mouse, will occur within approximately 2000 feet of GZM. For a larger, 50-lb animal, the threshold of lethality is greater than a peak overpressure of approximately 8 psi, which will occur within a distance of about 1100 feet. For birds in flight, the threshold of injury is at a peak overpressure of 5 to 10 psi, which will occur 1000 to 1400 feet from GZM.

An overpressure of 1 to 2 psi, which is the approximate threshold of structural damage to buildings and other manmade structures, will occur at a distance of 2800 to 5000 feet from GZM. Beyond this distance, damage is limited to sensitive architectural features such as window glass and plaster.

At peak overpressures less than approximately 0.4 psi, atmospheric conditions can refract the airblast toward or away from the ground, thus amplifying or reducing the peak overpressure that would otherwise be expected. In a calm, nonrefracting atmosphere, incident

Table 1. Explosions phenomena summary for 600 tons of ANFO (from Appendix A).

Phenomena	Magnitude of Phenomena
Airblast peak overpressure	
8 psi	1100 feet from GZM
5 to 10 psi	1000 to 1400 feet from GZM
3 psi	2000 feet from GZM
1 to 2 psi	2800 to 5000 feet from GZM
140 dB (0.029 psi)	14 miles from GZM[a]
200 Pa (0.029 psi)	14 miles from GZM[a]
Peak ground motion	
0.02 g-unit	2.2 miles from GZM
0.005 g-unit	5.7 miles from GZM
Crater dimensions	
Radius	72 feet
Depth	25 feet
Volume	175,000 cubic feet
Radius of continuous ejecta	400 feet from GZM
Maximum missile range	3000 feet from GZM
Explosion cloud	
Height of top of cloud	10,000 feet
Maximum downwind concentration of dust (75 miles downwind)	60 $\mu g/m^3$ (24-hr average)
Maximum downwind concentration of total gaseous pollutants or precursors (75 miles downwind)	10 $\mu g/m^3$ (24-hr average)

Note:

[a]In a calm, nonrefracting atmosphere.

airblast peak overpressures of approximately 200 Pa (0.029 psi), which can be expected to cause approximately one broken window in a populated area of 1000 people, can occur at a distance of approximately 14 miles. If strongly amplifying meteorological conditions were to be present, this distance could be increased by a factor of 3 to 8; however, meteorological conditions will be monitored and the HE charge will not be exploded when amplifying conditions for significant airblast in populated areas are present. Wind and temperature gradients that produce a decrease in sound velocity with altitude will be sought; such conditions can reduce the range of long-distance airblast damage by as much as a factor of 3.

Although airblast loses much of its impulsive characteristics at long distances, a peak level of 140 dB, which is the limit established by Occupational Safety and Health Administration regulations for industrial workers exposed to impulsive noise, can occur at a distance of 14 miles in a nonrefracting atmosphere.

Ground-motion magnitudes of 0.02 g and 0.005 g, which are useful criteria levels based on the extensive survey of ground-motion effects in Reference 6, are expected to occur no farther than 2.2 and 5.7 miles, respectively, from GZM. A magnitude of 0.02 g is annoying to humans, has a 1-percent probability of producing architectural damage to residences, and is the approximate threshold level for producing rockslides. At a magnitude of 0.005 g, damage will not occur to even the most sensitive structures.

The earth materials in the immediate vicinity of GZM will be crushed, fractured, and displaced to form a crater surrounded by ejecta. It is expected that the explosion will produce an apparent crater less than the size of the DICE THROW crater, which had a radius of 72 feet, a depth of 25 feet, and a volume of 175,000 cubic feet. Continuous ejecta will occur out to approximately 400 feet, and the maximum missile range will be approximately 3000 feet.

The explosion will create a number of gaseous detonation products, some of which are potential pollutants. The buoyant fireball draws these products up and also entrains large amounts of dust and larger soil particles. It is estimated that the 600-ton charge will produce an explosion cloud that will stabilize at a maximum height of approximately 10,000 feet above ground level, after which it will drift downwind and diffuse. About 1.7 percent of the crater volume will be contained within the explosion cloud at the time of its stabilization. Heavier particles will descend from the cloud fairly quickly, but the gaseous detonation products and fine dust particles can be transported long distances before reaching the earth. At the time of stabilization, the explosion cloud is expected to contain approximately 11 metric tons of carbon monoxide, 9 metric tons of nitric oxide, smaller amounts of other gases for which air quality standards exist, and no more than 135 metric tons of dust. Under worst-case diffusion assumptions, the maximum ground-level exposure to these pollutants will be approximately 75 miles downwind and will average 60 $\mu g/m^3$ over 24 hours for dust and 10 $\mu g/m^3$ over 24 hours for all gaseous products that are either air pollutants or possible precursors of air pollutants (primarily CO and NO).

The explosion will also produce heat, light, and an electromagnetic pulse, as does any explosion. For chemical explosions, no significant effects on humans or the environment from these phenomena have ever been observed.

Figure 3 shows an aerial view of the DICE THROW test bed following test execution.

Cleanup Phase

After the explosion of the HE charge, photographs of the effects on test objects will be taken, passive measuring devices will be retrieved, postshot measurements and data collection will be completed, and any postshot experiments that may be fielded will be conducted. The cleanup can then begin. Cables will be retrieved to the extent possible, experiments will be dismantled, debris will be hauled away to a disposal site, the crater will be filled with its ejecta, temporary buildings and trailers will be removed, test structures that are to remain will be prepared as necessary to be left in a safe condition, and the disturbed areas smoothed. Since the test area is in a WSMR missile impact zone, it is expected that the WSMR FE will allow structures to remain provided they are sound and safe, as was the case with DICE THROW. Site restoration construction activities will be conducted by the WSMR FE, and any soil stabilization and revegetation will be under his direction. Figure 4 shows a view of the DICE THROW test site following the cleanup phase.

THE TEST SITE ENVIRONMENT

It is proposed to conduct the MILL RACE HE field test in the northern portion of the White Sands Missile Range (WSMR) in south-central New Mexico. The proposed location of the test site is shown in Figure 5. WSMR is a National Range, operated by the U.S. Army with the primary mission of supporting missile development and test programs for the military services and other government agencies, and is a restricted area. Commercial, industrial, mining, agricultural, grazing, and recreational land uses are prohibited, except for selective hunting in season. All structures and facilities within the range are property of the range.

It is desired to conduct MILL RACE at WSMR for several technical and economic reasons:

- WSMR is a large, restricted area with adequate space to field a large HE test
- WSMR is an established test facility with the resources needed to support a large field test
- WSMR is relatively near DNA Field Command in Albuquerque, which will field MILL RACE
- A very similar test, DICE THROW, was conducted on WSMR near the proposed test site. The experience from fielding DICE THROW and the working relationships established between DNA and WSMR will considerably aid the MILL RACE Program.

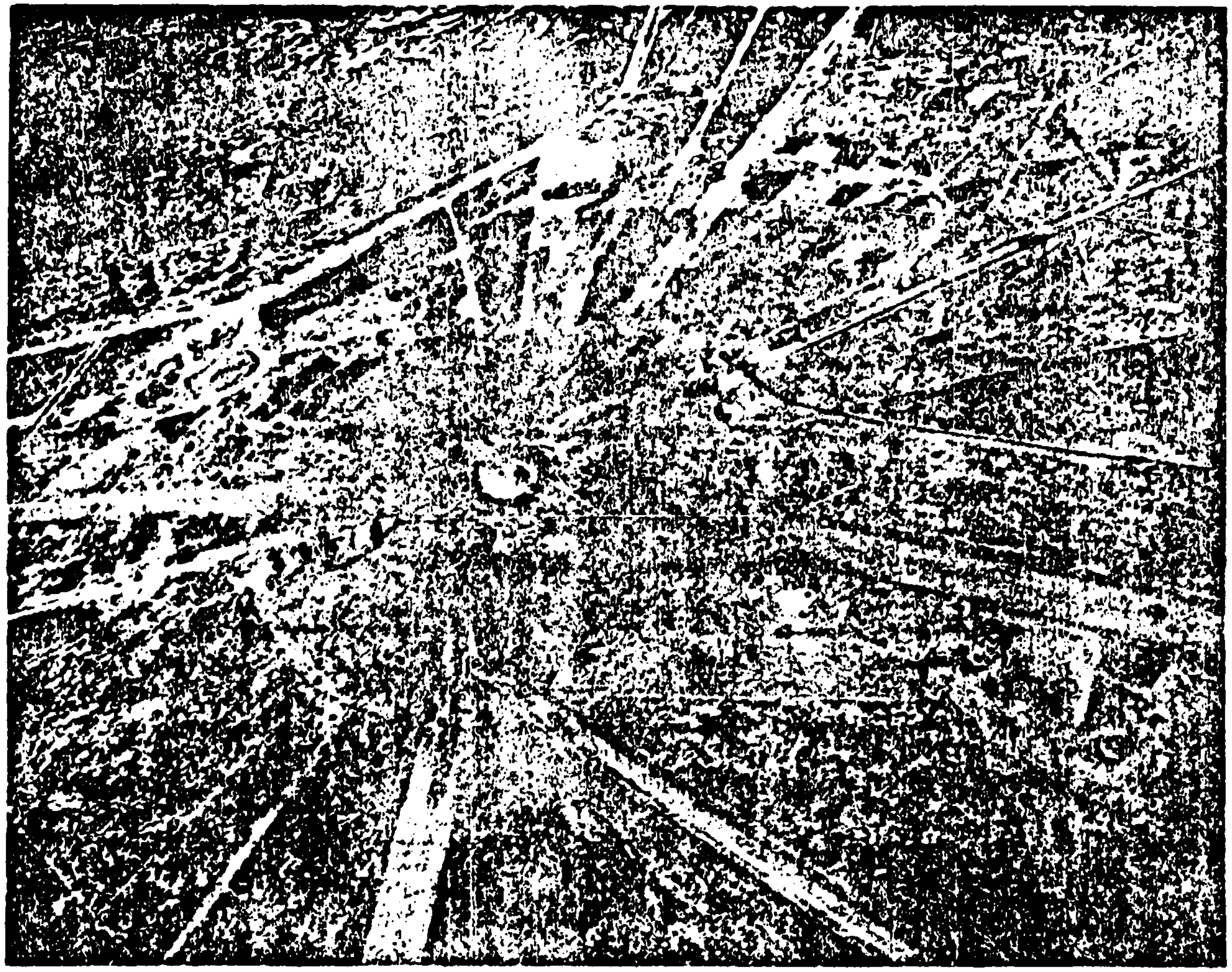

Figure 3. Postshot DICE THROW testbed. Aerial view locking southeast following test execution. (Source: Reference 2)

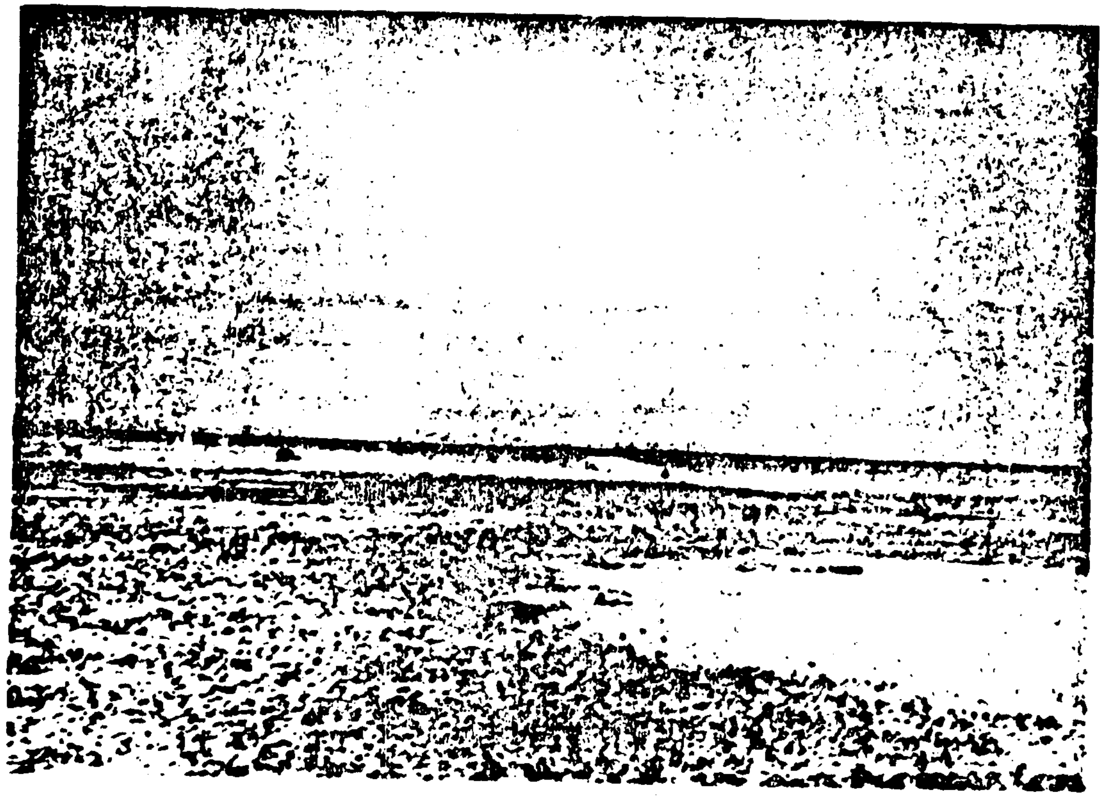

Figure 4. DICE THROW testbed after cleanup and site restoration. View looking north. (Source: Reference 2)

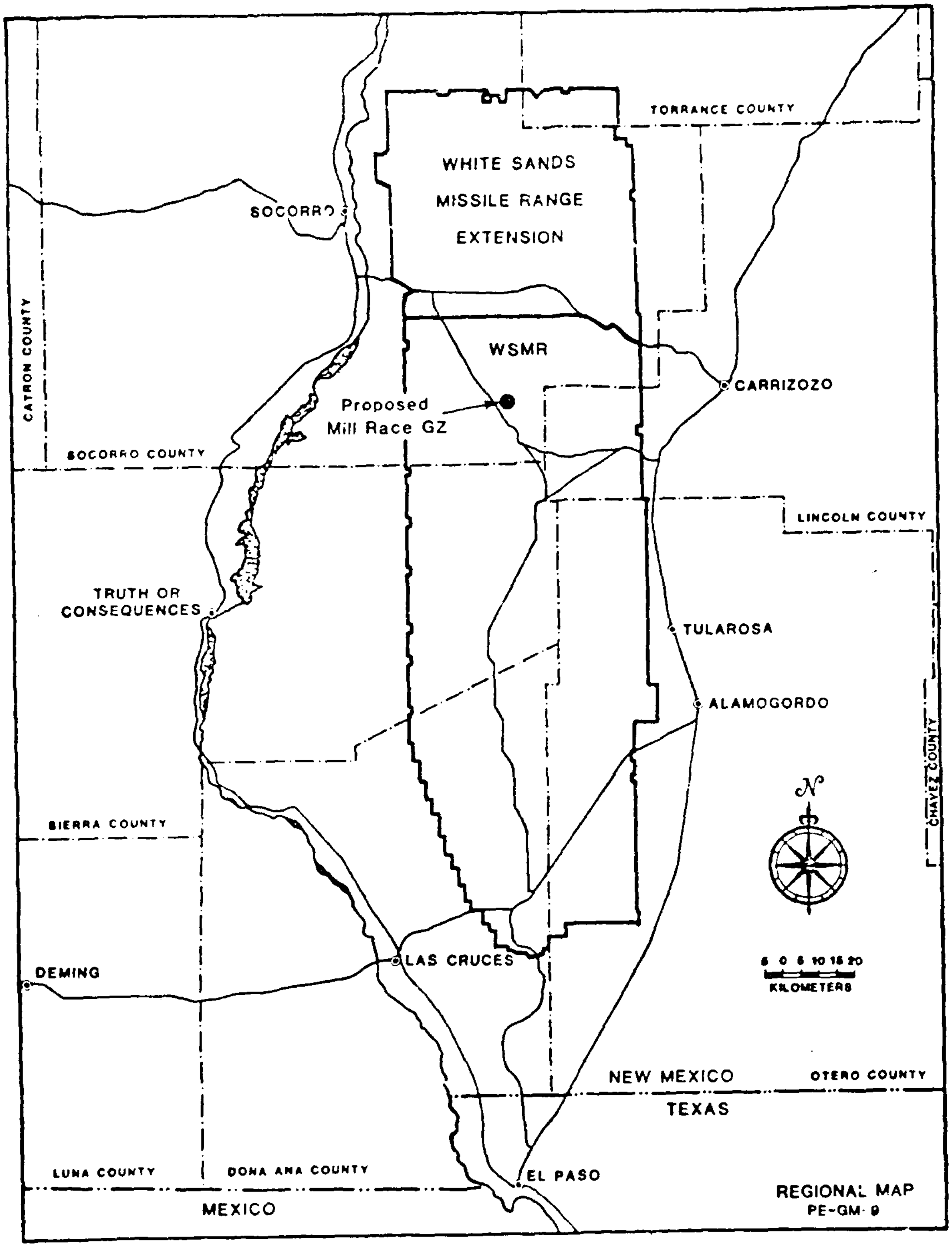

Figure 5. Layout map--White Sands Missile Range.
(Source: Reference 4)

In an environmental sense, the northern portion of WSMR is advantageous for an HE field test because it is quite remote from population centers and sensitive wildlife areas that might be disturbed or damaged by the construction activities and the test execution.

The proposed location of GZM (3000 feet east of Route 13) is shown in more detail in Figure 6. Other nearby potential locations for GZM were evaluated, but this particular location is desired because it best meets the following geologic criteria for ground shock experiments:

- Dry desert alluvium, similar to Area 10 of the Nevada Test Site
- Minimum caliche and boulder zones within the expected crater volume
- Depth to water table or bedrock of 60 meters or more
- A surface gradient of no more than 5 percent
- Reasonably uniform stratigraphy.

The other advantages of this site are:

- It is remote from the heavily populated post area of WSMR and from large civilian population centers, which reduces the possibility of any long-distance damage from airblast
- Conversely, it is relatively near the Stallion Range Center, the major uprange center, which can serve as a base of support
- Main WSMR roads and power and telephone lines are nearby
- It is quite near the DICE THROW site, the execution of which did not cause any known significant environmental impact.

The environment at the proposed test site shown in Figure 6 is described in this subsection and is based on the EIS for WSMR (Reference 4) and on the EA for DICE THROW (Reference 5).

The MILL RACE site is approximately 16 miles southeast of the Stallion Range Center, which is located near the northeast corner of WSMR. Distances from GZM to other features are shown in Table 2. The site is within the boundaries of an impact zone for missiles.

Physical Characteristics

The northern portion of WSMR contains the northern portions of two desert basins separated by the Oscura and San Andres mountain ranges.

The MILL RACE site is located at an elevation of approximately 4900 feet on alluvial soils in the northern portion of the Jornada del Muerto Basin, geologically described as a syncline. The test

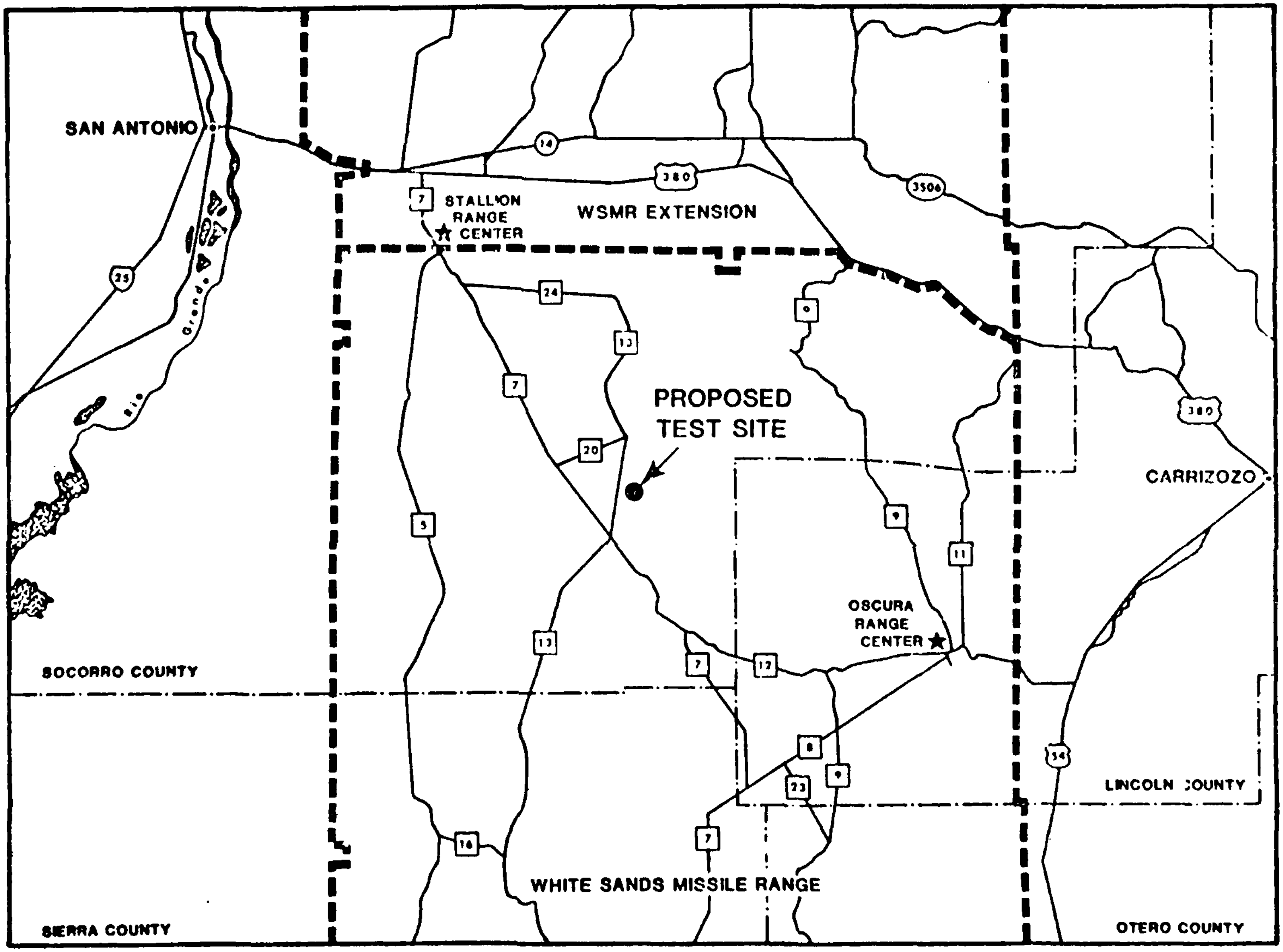

Figure 6. Location of the proposed test site shown in detail. (Source: WSMR Official Road Map).

Table 2. Relative positions of facilities and features of the environment from the test site.

Type	Name and Relative Location From GZM
Natural Features	
Nearest surface waters	Intermittent Lake, 9 mi southwest Intermittent Salt Creek, 5 mi east
Nearest marsh	Bosque del Apache area, 24 mi west
Nearest wooded area	Oscura Mountains, 8 mi east
Nearest wildlife refuge	Bosque del Apache, 21 mi west
Foothills of nearest mountains	Oscura Mountains, 4 mi southeast
Structures	
Nearest roads	WSMR Route 7, 1.5 mi southwest, and Route 18, 3000 ft west
Nearest overhead utility lines	1.5 mi southwest
Nearest underground structure	None known in area
Nearest instrumentation site	2 mi southwest
Nearest range center	13 mi northeast
Nearest boundary of WSMR	14 mi to north and west
Nearest well	Mockingbird Gap (non-potable), 7 mi southeast
Human and Socioeconomic	
Nearest non-test WSMR personnel station	North Oscura Range Center, 13 mi northeast
Nearest civilian population center	San Antonio (population 500), 30 mi northwest
Nearest larger city	Socorro (population 4087), 37 mi northwest
Nearest known archaeological site	Mockingbird Gap, Clovis Site, 11 mi northeast
Nearest historical site	McDonald Ranch House, 12,000 feet north
Nearest National Forest area	Lincoln National Forest, 37 mi west
Nearest civilian aircraft route	Outside WSMR boundaries (14 mi)
Nearest test personnel	6000 ft (in vans)

area is quite flat and the nearest mountains are approximately 4 miles southeast. The city of Socorro, 37 miles northwest, has a history of strong, but local, earthquake activity.

Copper, lead, and other mineral deposits exist in the nearby mountains and large amounts of gypsum are present; however, resource development is not economically feasible nor is mining permitted within the restricted boundaries of WSMR. Groundwater at the site is 240 feet deep and the waters of the Jornada del Muerto are also largely not potable. Groundwater movement is slowly westward to the Rio Grande River. Bedrock at the site is more than 400 feet below the surface.

During most of the year, the climate is typical of semiarid areas of the southwest desert. Days are typically sunny and annual rainfall averages from less than 8 inches in the basin to more than 16 inches in the mountains. Winds are typically from the west and are frequently gusty. However, in the summer months, moist, tropical air masses intrude from the Gulf of Mexico, causing prevailing winds from the southeast and thundershowers. Annual precipitation at the site averages about 12 inches, with more than half of the precipitation occurring in the three summer months. The highest wind speeds occur in the spring when dust storms are common. The month of April is consistently the windiest month of the year. Wind speeds are typically lowest in the fall.

Biological Characteristics

The test site has an arid environment. It lies within the Sonoran Life Zone of a northern extension of the Chihuahuan Desert. WSMR vegetation maps classify the site as a sand grasslands and dunes association near a semidesert shrub association, and visitors to the site confirm that these classifications are correct. The immediate vicinity of GZM is grasses and low vegetation with an occasional yucca and cactus while creosotebush, characteristic of a semidesert shrub association, is abundant nearby. The grasslands provide good forage resulting in a relatively high (for an arid environment) biological carrying capacity. Conversely, creosotebush tends to exclude all other types of vegetation, resulting in very poor grazing values and low biological carrying capacity.

Reference 4 lists 99 mammals whose geographic range includes WSMR. Mammals that are listed as abundant or common for sand grasslands (of the adjacent Tularosa Basin) are the Desert Pocket Mouse, Merriam's Kangaroo Rat, Ord's Kangaroo Rat, the Deer Mouse, and the Southern Plains Wood Rat. Of the larger mammals the coyote, deer, or bobcat would be rarely seen. Some wild horses and the gemsbok, an introduced species, roam over WSMR. It is difficult to estimate the types and numbers of small animals expected at the test site because types and numbers of such animals vary considerably. Based on small mammal surveys at grassland biomes near WSMR, the five common or abundant animals listed above and other types of mammals might be found at the test site; these are nearly all various species of mice and rats, or ground squirrels, with an occasional jackrabbit or cottontail. The densities of common species might vary from less than one per acre to over 20 per acre. An average of two mammals per acre might be expected.

WSMR is included in the range of four rare or endangered species of mammals: the spotted bat, Mexican wolf, grizzly bear, and black-footed ferret. None of these animals has been reported within WSMR, nor have the coati and jaguar, which are classified as peripheral species. The Arizona black-tailed prairie dog and the Mexican vole, on the "status undetermined" list, have been sighted within WSMR but not in the vicinity of the proposed test site.

Typical birds in the area include the horned or desert lark, the cactus wren, pyrrhuloxia, black-throated sparrow, white-necked or desert raven, Sainsons hawk, and sage sparrow. Surveys for grassland areas are not available, but based on surveys in semidesert shrub areas, an average of one bird for several acres might be expected in the vicinity of the test site. The rare or endangered prairie falcon, bald eagle, Mexican duck, peregrine falcon, and spotted owl prefer a different habitat than the area of the test site.

None of the reptiles reported at WSMR is listed as a rare or endangered species. Reptile counts at the Jornada Experimental Station in the southern portion of WSMR indicate 10 to 15 reptiles per acre, almost exclusively whiptail lizards. The nearest habitat of the unique WSMR pupfish is approximately 20 miles southeast of the site.

No species of animal uses the environment in the vicinity of the test site to the extent that a change in that environment could have a significant effect on the survival of that species.

Socioeconomic Environment

The four counties comprising the northern portion of WSMR are very sparsely populated. Socorro, Sierra, and Lincoln counties average approximately 1.5 persons per square mile. The nearest communities are San Antonio, population approximately 500, 30 miles northwest; Carrizozo, population 1123, 35 miles east; and Socorro, population nearly 5000, 38 miles northwest (1970 population statistics). Albuquerque is approximately 100 miles north.

Due to its proximity, onsite test personnel are likely to stay in Socorro. Other communities with sufficient facilities are much more distant. Based on inquiries in 1976 for DICE THROW, Socorro has 220 motel rooms with an annual average occupancy rate of 70 percent. The peak occupancy period is from May through September.

Cultural Resources

The only historical site near the proposed MILL RACE site is Trinity, the site of the first atomic bomb test, which is a few miles north. The Trinity historical site consists of a monolith within a fenced area denoting GZ, some nearby underground structures, and the McDonald Ranch where the Trinity device was assembled.

The McDonald Ranch structures are in very poor condition. The ranchhouse itself has 18-inch-thick rock and adobe walls and a corrugated metal roof over wood planking. The window panes are all gone and the sheetrock ceiling has fallen or is hanging in many places. Most of the roof rafters on the north side of the house and some of those on the west side have been fractured, apparently from excessive external roof loading. Since the ranchhouse is only about 12,000 feet from the 19-KT Trinity nuclear test, it is presumed that the airblast from Trinity caused this fracturing. The fractured rafters have been pushed back out and braced with vertical 2 x 4's. The ceiling joists have also been braced with temporary wood supports in some of the rooms.

Other structures of the McDonald Ranch include two other buildings, apparently a barn and living quarters, both of which do not have roofs; a wooden truss which once supported a windmill; a corral of barbed wire and sticks; and a water storage reservoir.

The McDonald Ranch is in a deteriorated condition and is a relatively long distance (12,000 feet) from GZM. Nevertheless, because the ranch is a recognized historical site, a structural analysis was conducted to determine if airblast or ground motions from the MILL RACE explosion might further damage the structures. The results of this analysis are discussed in Section 3.

The nearest archaeological site reported in the WSMR installation EIS (Reference 4) is the Mockingbird Gap Clovis site approximately 11 miles to the north, but the vicinity of GZM has not been surveyed. DNA has arranged, through WSMR, to have the New Mexico State University conduct an archaeological survey of the area within a radius of 12,000 feet of GZM. No significant archeological sites were found.

There are no national forest areas within 30 miles of the site. The boundary of the Bosque del Apache National Wildlife Refuge is approximately 21 miles west. Hunting by base personnel in season is permitted in the area of the test site.

SECTION 3
ENVIRONMENTAL IMPACTS

In this section the construction, test execution, and cleanup phases of the proposed MILL RACE Program are analyzed to assess their impacts on the natural physical and biological environment and on humans and their socioeconomic environment.

CONSTRUCTION PHASE

Site preparations of the construction phase will result in the denuding of vegetation and the disturbance of approximately 120 acres of land. This disruption will last through all onsite phases of the project, a total of approximately 12 months. Following the cleanup phase, the area will slowly revegetate.

The vegetation at the test site is primarily grass and other low-growing vegetation, which has good food values for foragers and grazers. This 120 acres of denuded land would support a large grazing animal, such as a horse, for about 13 months, based on the estimate of 9 acres of grasslands per animal-unit-month cited in Reference 4. Based on estimates of animal densities from surveys in the vicinity of WSMR, it is estimated that the following types and numbers of small animals will lose their habitat from the denuding and disturbance of these 120 acres:

250 small mammals, mostly mice and rats with some ground squirrels and rabbits

40 birds, mostly insect eaters and seed eaters

1200 to 1800 reptiles, almost entirely whiptail lizards.

(Animal densities in desert areas typically vary considerably depending on the food supply, so the actual numbers of animals displaced by MILL RACE may be significantly greater or less than indicated by these estimtes.)

Although most of these displaced animals will move into undisturbed areas and try to displace their neighbors, animal numbers in desert areas are limited by the food supply, and displaced animals can be expected to die. The loss of 120 acres of hunting territory should not significantly affect the larger predators, such as the coyote, that typically range over wide areas.

From a less localized viewpoint, no unique habitat will be disturbed, nor will the disturbed area be a significant portion of similar habitats in the vicinity. The 120 acres of grassy sand grasslands and dunes vegetation association comprise 0.21 percent of the 57,000 acres of such vegetation on WSMR. Endangered animal species will not be affected.

The construction activities will not have any effect on the Trinity historical site, parts of which are between 2 and 4 miles north of the desired GZ location. Reference 4 does not indicate any known archaeological sites, but the area had not previously been surveyed for artifacts. An archaeological survey has now been conducted by the New Mexico State University to determine if archaeological sites that might be adversely affected by MILL RACE activities are in the area. The results of this survey now available, indicate no significant sites have been found.

The construction activities will produce the noise, dust, traffic, vehicle exhaust emissions, and construction wastes that are inherent with construction projects. However, the site is remote from any people so these effects should not be significant beyond the immediate vicinity of the test site. The numerous excavations for experiments will not have any significant effect beyond those from the disturbance of the ground surface.

Potable water use for the project will be insignificant compared to the requirements for the approximately 10,000 personnel on WSMR. Potable water will probably be hauled from Stallion Range Center, whose desalinization system with a capacity of 100,000 gallons per day supplies all uprange users.

Motels and restaurants in the nearby communities, primarily Socorro, will benefit economically from housing and feeding the construction work force. No other socioeconomic effects appear to be significant. The proposed program is not large in comparison to ongoing programs of WSMR.

In summary, the construction activities will result in economic gain to the local communities and the loss of 120 acres for natural uses for a relatively long time.

EVENT EXECUTION PHASE

During the event execution phase, some construction, instrumentation, and cleanup actions will occur, but the only potentially environmentally significant project actions will be from the explosions phenomena of the detonated HE charge. Some of the equipment involved in the experiments have potentially hazardous aspects and will therefore have to be considered from project safety aspects. Such equipment includes HF, microwave, and laser communication and sensing equipments. None of these equipments, whose use at WSMR is not unusual, can be envisioned as having any effect outside the boundaries of WSMR.

Radiant heat from the TRSs could ignite dry grass within 35 feet. Since the TRSs will be within areas assigned to experiments and mostly within the 3- to 5-psi range, where construction activities and airblast are more likely damage mechanisms, the thermal effects of the TRSs or removal of vegetation to prevent fire should not be significant. Should a nozzle fail to ignite, because of failure of the pilot light or for some other reason, the aluminum powder and oxygen mixture would probably be ignited by the flame from the adjacent nozzle. If the mixture still should not ignite, it would drift downwind and diffuse. There does not appear to be any significant hazard from such an occurrence because the aluminum powder will separate from the oxygen and settle to the ground, probably within a few hundred feet.

The magnitudes of the explosions phenomena from a 600-ton ANFO charge are estimated, using generally worst-case assumptions, in Appendix A. In this section, the magnitudes of the explosions phenomena are evaluated against the environment at the test site to assess the environmental impact of the event execution phase.

Effects of Airblast

The environmental effects of airblast and noise are described in detail in Reference 6 and the peak overpressure levels that have environmental significance are shown in Table 3. The distances from the 600-ton charge at which these overpressure levels will occur have been determined in Appendix A and are also included. From Table 3, it can be seen that little damage to biota from airblast will occur at overpressure levels below 3 psi, i.e., beyond about 2000 feet from GZM. The threshold of lethality to a 50-lb animal in the open occurs within about 1100 feet and birds in flight can be injured at distances within 1000 to 1400 feet. It is unlikely that a large animal would be close enough to the explosion to be injured without being noticed and driven away. Injuries and deaths to animals should be limited to the small animals (primarily rodents and lizards) that inhabit the test area vicinity, none of which are endangered species. The rodent trapping portion of the environmental monitoring program for the MISERS BLUFF Phase II field test program indicated that rodent populations were depleted more by the site preparation phase of the program than by the explosions effects (Reference 7).

There are no large trees within the 1000 feet at which they might be toppled. Vegetation damage will be limited to the grasses and other low-growing and small plants that are within 2000 feet of GZM. Desert plants are adapted to withstand strong winds. As can be seen from comparing photographs before and after the execution of DICE THROW (Figures 2 and 3), the vegetation beyond the 400-foot range of continuous ejecta did not appear to be greatly affected by that test execution.

The only buildings of concern in the vicinity of the test site are the McDonald ranchhouse and outbuildings. Other buildings and manmade structures are at least 1 mile away and will be exposed to overpressures significantly less than the 1- to 2-psi threshold of structural damage. Although the ranch buildings are about 12,000 feet from GZM, where the peak incident overpressure will be only about 0.35 psi (peak reflected overpressure of 0.70 psi), which normally will cause only architectural damage such as broken windows and cracked plaster, the ranch buildings are part of a national historical site and were reported to be in very poor condition. Because of their historical significance and deteriorated condition, an independent structural survey and analysis of the buildings was undertaken. As documented in Reference 9, it is concluded from this survey and analysis that there is a high probability that no substantial damage will occur to any of the structures at the McDonald Ranch.

Table 3. Summary of levels and extent of airblast damage criteria.[a]

Effect	Corresponding Incident Peak Overpressure Level	Distance From GZM at Which Overpressure Level Occurs
Threshold of lethality		
Small animals in the open	3 - 6 psi	1250 - 2000 ft
50-lb animal in the open	>8 psi	<1100 ft
Small animals (rabbits or smaller) in burrows	10 psi[b]	1000 ft
Larger animals in burrows	18 psi[b]	750 ft
Threshold of lung damage to animals in burrows		
Small animals	3 psi[b]	2000 ft
Large animals	6 psi[b]	1250 ft
Threshold of eardrum rupture to animals in the open	3 - 5 psi	1400 - 2000 ft
Threshold of injury to birds in flight	5 - 10 psi	1000 - 1400 ft
Toppling of broadleaf trees (small leaves or defoliated or light crowned)	>10 psi	<1000 ft
Damage to small vegetation or tree branches	3 psi	2000 ft
Structural damage to buildings	1 - 2 psi	2800 - 5000 ft
Window breakage (one window for each 1000 of human population)	200 Pa (0.029 psi)	14 mi[c]
Impulsive noise level limit for industrial workers by Occupational Safety and Health Administration (OSHA)	140 dB (0.029 psi)	14 mi[c]
Tinnitus or "ringing" of ears	160 dB (0.29 psi)	1.8 mi[c]

Notes:

[a]Summarized from Reference 6.

[b]The peak overpressure levels shown are the levels that occur without reflections. Airblast filling a burrow can produce pressures that are 2 to 3 times these values and are sufficient to result in the effect that is described.

[c]Assuming a calm, nonrefracting atmosphere.

The structures were exposed to airblast from the 19-KT Trinity nuclear test, which was approximately 3 times greater than the airblast that will occur from MILL RACE. The walls survived this airblast loading and although the roof rafters were fractured, the roof did not collapse. It is expected that, at most, airblast from MILL RACE may cause some of the loose sheetrock that is hanging from the ceiling to fall (much of the sheetrock has already fallen to the floor) or possibly topple some loose rubble from the tops of walls.

The specialist who performed the structural analysis does not believe that it is necessary, as a conservative measure, to strengthen the McDonald Ranch structures prior to their exposure to airblast from MILL RACE (personal conversation). He concludes that the structures are sound enough to withstand any structural damage.

The structural analysis was based on the assumption of 0.35-psi peak overpressure at the ranch, which was obtained from the predicted overpressure versus distance calculations for DICE THROW. At this level, airblast may be refracted by wind and temperature gradients. To ensure that the overpressure will not significantly exceed 0.35 psi at the McDonald Ranch, the meteorology team for MILL RACE should assure that airblast ducting conditions do not exist at the time of firing. Gradient conditions will reduce the airblast at the McDonald Ranch to below 0.35 psi.

A noise level of 160 dB (0.29 psi), which should occur in the open approximately 1.8 miles from GZM, can cause tinnitus, a "ringing" of the ears with a temporary degradation in hearing ability. This noise level will occur about at the administration area if the area is sited 10,000 feet from GZM as was the case for DICE THROW. No one should be in the open at the administration area. At the 6000-foot range from GZM, where project personnel will be located in the instrumentation park vans, the outside noise level will be approximately 169 dB. If the van structures cannot attenuate noise inside to a level below the 140-dB limit established by the Occupational Safety and Health Administration (OSHA) regulations for workers, ear protection may be required for these project personnel. The experience from DICE THROW can be applied.

Theoretically, any people in the open within approximately 14 miles of the test site may be exposed to noise levels in excess of the 140-dB standard for workers exposed to impulsive noise (assuming a calm, nonrefracting atmosphere, but even with strong gradient meteorological conditions, the 140-dB range would extend to 4 miles from the test site). Since 14 miles is the approximate distance to the nearest boundaries of WSMR, no unauthorized personnel will be within the distance where they would be exposed to excessive impulse noise. Since WSMR has control over travel and working uprange, all personnel can be restricted to beyond the 140-dB distance or furnished with ear protection, if such is believed necessary.

It should be pointed out that the 140-dB limit is intended for industrial workers exposed daily to impulsive noises rather than occasional exposure to distant explosive noise. At distances of several miles or more, the explosive noise will lose much of its impulsive characteristics since high-frequency components undergo greater attenuation. At long distances, explosive noise sounds like a rumble which the ear strongly discriminates against. Although a low-frequency 140-dB noise level may startle animals and humans, there is no firm evidence to indicate that occasional impulse noises below the level that physically damages organisms produce any lasting significant adverse effects. For perspective, the ear of a person firing a handgun is exposed to noise levels from 140 to 170 dB (Reference 6), or as much as 30 times greater sound pressure than the 140-dB OSHA standard.

Explosives airblast and noise can cause nuisance damage such as cracked windows or annoying noise at great distances from the source of the explosion, especially if meteorological conditions are conducive to blast enhancement in populated areas. Assuming a calm, nonrefracting atmosphere, the peak overpressure level at the nearest WSMR boundaries will be 200 Pa, i.e., 0.029 psi or approximately 140 dB SPL (Sound Pressure Level). Under normal atmospheric conditions, blast energy will be refracted upward, resulting in lower peak overpressures and sound pressure levels than would be expected in a calm, nonrefracting atmosphere; however, under inversion conditions, the peak overpressure might be greater by a factor of 3 than expected in a nonrefracting atmosphere. In this latter case, the peak overpressure might be on the order of 0.1 psi, and the corresponding sound pressure level would be 150 db SPL at the near boundaries, which would be loud but would not cause ear damage.

Based on a large amount of data and theoretical studies, Reed has formulated mathematical models for estimating window breakage as a function of low-pressure airblast levels and separation distances (Reference 8).

The counties comprising the northern part of WSMR are very sparsely populated. Socorro, Sierra, and Lincoln counties average 1.7 to 1.9 people per square mile; Otero county has a population of 41,000, but over half of this population (23,000) lives in the city of Alamogordo. Therefore, it can be assumed that the area adjacent to the northern portion of WSMR has a population density of 2 people or less per square mile, which certainly qualifies it as a "rural" area. For "rural" areas with a uniform population density and no population centers, Reed recommends that the following equation be applied to estimate the size of the explosion that can be expected to result in "no window damage" (i.e., statistically, the probability of breaking one or more windows is less than 0.5):

$$W_e = 40\ R_r^3 \tag{1}$$

where

W_e = TNT-equivalent weight of explosive (kg)

R_r = distance to nearest residence (km).

Assuming the nearest residence is at the nearest border of WSMR, approximately 14 miles from GZM, the maximum weight of explosive that could be expected to result in no window damage is slightly over 500 tons TNT-equivalent. Therefore, the proposed MILL RACE HE charge should not cause any window damage in the rural areas adjacent to WSMR.

The greatest concern in large-scale, HE field tests is the possibility of breaking windows in population centers at long distances from the test site. Even though the airblast levels at long distances may be quite low, resulting in a very low probability of breaking an individual window pane, a large number of windows may be exposed in even a moderately sized town. Reed has developed relationships between distances from GZ to population centers, numbers of residents, and meteorological conditions for estimating the number of broken windows that might result from a large HE explosion. Table 4 shows the estimates for DICE THROW; since GZM will be only 5 miles from the DICE THROW site and the size of the explosion will be the same, these estimates can be applied for the proposed MILL RACE field test. Table 4 shows that only for atmospheric inversion or focusing conditions would significant numbers of windows be broken. For the expected gradient conditions, no broken windows should result outside the boundaries of WSMR. Meteorological conditions will be monitored prior to explosion of the charge so that the presence of any blast-amplifying conditions will be known.

Table 4. Number of broken windows predicted for DICE THROW, for various airblast propagations. (Source: Reference 2)

City	Population (1970)	Distance From GZM (km)	Atmospheric Propagation Type			
			Gradient	Standard	Inversion	Focusing
Alamogordo	23,035	100	0	0	0	38
Tularosa	2,851	81	0	0	1	6
Carrizozo	1,123	60	0	0	1	5
Socorro	4,667	53	0	1	13	51
Albuquerque	270,000	155	0	1	17	70

In summary, no broken windows in civilian areas should result from the proposed MILL RACE explosion provided that gradient conditions exist in the direction of population centers at the time of the explosion. Such gradient conditions normally are not difficult to obtain. No broken windows were reported from DICE THROW, even though blast-amplifying conditions were present.

Effects of Craters, Ejecta, and Missiles

No significant effects from these phenomena are foreseen. The crater will be in dry alluvium soils and will be filled with the ejecta during the cleanup phase. No lasting significant effect will result. The limit of continuous ejecta will be approximately where the airblast peak overpressure is approximately 100 psi; thus, damage to vegetation and any animals will be dominated by airblast. There will be no humans within the maximum missile range of approximately 3000 feet and the probability of striking an animal that survived airblast will be very small.

Effects of Ground Shock

The effects of ground motions on humans, animals, buildings and other manmade structures, and geological formations have been surveyed from the available literature and reported in Reference 6. Based on this survey, the following criteria can be assumed as conservative:

1. Animals will not be injured by ground motions up to at least several g's

2. A level of 0.02 g is annoying to humans, has approximately a 1-percent probability of producing architectural damage (e.g., plaster cracks) in a residence, and is a level below which rockslides have not been known to result

3. A level of 0.005 g is perceptible to humans but will result in no damage to even the most sensitive structures.

Ground motions in excess of several g's or more will occur only within a few hundred feet of GZ, where damage to animals from airblast will dominate. Therefore, it can be assumed that ground motions will not be damaging to animals in the vicinity of the test site.

The criterion of 0.02 g will occur approximately 2.2 miles from the test bed. The only humans and structures within this distance will be project personnel and the vans and equipment in the instrument park, WSMR Highways 7 and 13, wooden-pole electric power lines, and the McDonald Ranch buildings. Based on the structural analysis (Reference 9), none of the McDonald Ranch structures will be damaged by ground shock. The test personnel will not be harmed in any manner by the ground-motion levels and none of the structures will be damaged. (See Reference 6 for a discussion of the much higher ground motion to which utility poles, wells, pavements, etc. have been subjected in underground nuclear tests without significant damage.)

The criterion of 0.005 g will occur approximately 5.7 miles from the test beds. There are no "unusually sensitive" structures within this distance.

The only way in which ground shock can affect a water table is by fracturing bedrock that supports or restrains groundwater (i.e., a perched or an artesian water table). Since bedrock at GZM is greater than 400 feet below the ground surface, the ground shock will not have any effect on bedrock or the water table.

In summary, ground shock will not result in any significant environmental damage. The distances at which ground motions might be significant are all within distances at which airblast is the primary damage mechanism. Significant effects from ground shock from the equivalent-sized DICE THROW event near this same site were not reported.

Effects of Explosion Products and Dust

Table A-1 in Appendix A lists the types and quantities of chemical products that are forecast to result from the detonation of a 600-ton ANFO charge. Over 98 percent (by weight) of these products consists of water, nitrogen, oxygen, and carbon dioxide, which occur naturally in the air and are harmless (unless the nitrogen and carbon dioxide occur in such high concentrations that they displace oxygen from the lungs) and which will not affect soil or water. However, some of the predicted chemical species are classified as pollutants in air or water.

The chemical species that might affect soil or water are the nitrogenous and cyanide compounds. Nitrogenous compounds may beneficially increase soil fertility, but nitrates and cyanide are undesirable in water.

An extensive soil and water collection and analysis program was conducted as part of the environmental monitoring plan for the MISERS BLUFF Phase II field test. The results of this program (Reference 7) indicate that ANFO explosions do not increase the salinity or cyanide concentration of soils and water. However, following the explosive tests, an increase in nitrate concentration was observed in one well that intersected the underwater flow from the crater area. The investigators concluded that the increase was probably caused by an increase in the nitrate levels in ejecta that was used to fill the explosion craters; however, laboratory studies indicated that if this were the case, increased chloride levels should also have occurred and this was not observed. Regardless, the groundwater at the MILL RACE site is deep and is not potable and any increase in the nitrate concentration would have no effect.

In Appendix A, the maximum total exposure to all gaseous products that are either air pollutants or possible precursors to air pollutants (primarily CO and NO_x) is calculated to be equivalent to a 24-hour average of about 10 $\mu g/m^3$ and will occur approximately 75 miles downwind. This concentration is considerably less than that permitted for any such pollutant by Federal and State of New Mexico ambient air quality standards.

Concern has been expressed as to whether the explosion products listed in Table A-1 might produce nitrosamines. This question is of interest because nitrosamines (or, more broadly, N-nitroso compounds) are extremely potent carcinogens. Nitrosamines are produced when certain nitrogen-containing compounds react with secondary amines, a group of organic compounds which can be considered as derived from ammonia with two of the hydrogen atoms replaced with organic radicals. The remaining nitrogen atom in the amine links with a nitroso group (i.e., a NO radical) to form the N-nitroso compound. Since Table A-1 indicates that several nitrogen compounds are produced by the explosion of ANFO and since secondary amines are widely distributed in the environment, it would not be surprising if nitrosamines are produced. It does not appear that the question of nitrosamines has been addressed before in the context of explosives products. Ammonium nitrate is a common fertilizer and has been used as a blasting agent for many years.

Despite being potent carcinogens, it is known that nitrosamines are widely distributed in the environment--they are formed in soil and water by the reaction of nitrogen compounds with naturally occurring amines, they are present in tobacco smoke, they are formed in the human stomach when nitrites are ingested, and they occur in human saliva. Since the vicinity of the proposed test site is comprised of desert vegetation and is not used for human food crops or water supply, it does not appear that any human hazard would result even if nitrosamines are produced.

Based on conservative assumptions, the maximum ground-level concentration of dust from diffusion of the explosion cloud has been calculated in Appendix A to be less than 60 $\mu g/m^3$ averaged over 24 hours; compared with the New Mexico standard and the national secondary ambient air quality standards limit of 150 $\mu g/m^3$, the maximum dust concentration from diffusion of the explosion cloud will be less than the permitted maximum by a factor of about 3. (The above analysis for dust considers only the light dust in the explosion cloud that is subject to long-distance transport and diffusion. Of course, substantial amounts of heavier earth particles will fall to earth in the vicinity of the test beds.)

Summary

In summary, airblast will dominate the effects of other explosions phenomena. Airblast can destroy or injure plants and animals within a 2000-foot radius of a 600-ton ANFO explosion. The potential for breaking windows and causing excessive noise in populated areas at longer distances can be forestalled by ensuring that the charges are not exploded when meteorological conditions, which will be monitored onsite, might enhance airblast toward the population centers. Based on a structural analysis, ground shock or airblast will not cause any significant damage to the McDonald Ranch. There will not be any significant effect from the explosion craters, which will be filled with the crater ejecta. Ejecta coverage is well within the range at which airblast damage dominates, and it is extremely unlikely that a missile might strike an animal beyond the range at which injury from airblast is likely. Ground shock will not have any significant adverse effect on humans, animals, or structures. The chemical explosion products may increase the concentration of nitrates in the soil, but the groundwater is deep and not potable and any increase will not have any significance. Distant maximum downwind concentrations of dust and chemical air pollutants in the explosion cloud will be temporary and well within the most restrictive air quality standards.

CLEANUP PHASE

No significant adverse environmental effects are foreseen from the site cleanup phase. Debris and waste will be collected and hauled to the WSMR landfill, except for concrete debris which may be buried at the site in the explosion crater. The filling of craters and excavations, extraction of instrumentation and wiring, removal of vans and temporary buildings, and site leveling will all take place on ground that has already been disturbed by the construction and testing phases.

Revegetation of the approximately 120 acres of disturbed land will be provided as deemed necessary by the WSMR Facility Engineer.

SECTION 4
AGENCIES AND PERSONS CONSULTED

This environmental assessment was prepared by Kenneth E. Gould and Richard H. Rowland, both of General Electric-TEMPO and both of whom have eight years of experience in preparing environmental documents for DNA-sponsored field tests, including those for PRE-DICE THROW, DICE THROW, and DISTANT RUNNER at WSMR. The services of Dr. Tom Paez, an associate professor in the Civil Engineering Department of the University of New Mexico, were purchased to perform a structural analysis of the historical McDonald ranchhouse to analyze the potential for damage from blast and shock from the test execution. DNA has arranged, through WSMR, to have the New Mexico State University conduct an archaeological survey of the proposed MILL RACE site.

Because of the documentation that was available regarding HE field tests and the particular test site, there was little need to consult other persons and agencies. Persons contacted were:

> LCDR Gary Reid and Capt. Rodney Grayson, Test Group Director and Deputy Test Group Director for MILL RACE, DNA Field Command, Albuquerque, New Mexico
>
> Mr. Albert Johnson, White Sands Missile Range, Environmental Engineer.

In coordination with WSMR, DNA has consulted with the following agencies regarding this environmental assessment:

> Bureau of Land Management
>
> Environmental Improvement Division of the State of New Mexico
>
> U.S. Forest Service
>
> U.S. Army Corps of Engineers, Water Resources Division
>
> New Mexico Game and Fish Department.

SECTION 5

CONCLUSION OF WHETHER TO PREPARE AN EIS

The proposed MILL RACE Program, as described in this assessment, is not likely to result in significant environmental impacts or be environmentally controversial. The archaeological survey of the area did not reveal any cultural resources in areas that would be disturbed by construction activities. Consequently, an environmental impact statement is not required by regulation or law.

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2. Proceedings of the DICE THROW Symposium 21-23 June 1977 (3 volumes, DNA 4377P-1, General Electric-TEMPO, Santa Barbara, California, July 1977.

3. Preliminary MILL RACE experimental data sheets and other materials furnished by DNA.

4. U.S. Army White Sands Missile Range Installation Environmental Impact Assessment, Department of the Army, March 1976 (revised 1 May 1978).

5. Environmental Impact Assessment for DICE THROW High-Explosive Field Test Program (Main Event), DASIAC ES 76-3, General Electric Company-TEMPO, Santa Barbara, California, September 1976.

6. Environmental Impact Assessment for Phase II of the MISERS BLUFF Field Test, Defense Nuclear Agency, September 1977.

7. Perry, G.L.E., et al., Environmental Monitoring--MISERS BLUFF Phase II, General Electric-TEMPO for DNA, POR-7016, 30 June 1979.

8. Standard for Single Point Explosions in Air, American National Standards Institutes, Committee on Mechanical Vibration and Shock, S-2, Atmospheric Blast Effects Working Group, S-2-54, Jack Reed, Chairman, third draft, 20 July 1976.

9. Paez, T.L., MILL RACE Damage Assessment of Structures at the McDonald Ranch, General Electric-TEMPO for DNA, GE80TMP-53, November 1980.

APPENDIX A
EXPLOSIONS PHENOMENA

For the MILL RACE field test program, it is proposed to explode a 600-ton charge of ammonium-nitrate and fuel oil (ANFO) to simulate the blast and shock from a 1-KT nuclear weapon surface burst. The ANFO charge will be constructed on the ground surface in the shape of a cylinder with a hemispherical cap. The explosion of such a charge will produce airblast (and noise), a crater with ejecta surrounding the crater and missiles at greater ranges, ground shock, explosives detonation products, and a buoyant cloud that will carry dust and detonation products downwind. The magnitude of these phenomena are estimated in this appendix. These magnitudes should be quite similar to those from the DICE THROW event, also a 600-ton charge of ANFO that was exploded in 1976 near the proposed MILL RACE site.

AIRBLAST

Damage by airblast is customarily related to the peak overpressure of the airblast wave. Figure A-1 shows the peak overpressure versus ground distance predicted for DICE THROW; the measured pressures were generally consistent with this prediction. The pressures shown in Figure A-1 range from those that cause complete destruction of animals and vegetation and most aboveground structures to those that cause only architectural damage to buildings. Since the MILL RACE explosive charge will be of the same size, type, and shape as the DICE THROW charge and the proposed test site is near the DICE THROW site with nearly the same elevation, the peak overpressure from MILL RACE will be essentially as predicted in Figure A-1.

Previous field tests and experiments have verified that for the overpressure range of most environmental interest (below about 20 psi), the peak overpressure versus ground distance curve will be approximately the same regardless of charge shape and that 600 tons of ANFO produce airblast equivalent to that from 500 tons of TNT or from about 1 KT nuclear.

Where the airblast peak overpressure is approximately 0.4 psi, at a distance of approximately 2 miles, the shock wave will have slowed to the point where it approaches the speed of sound, i.e., approaches an acoustic wave, which can be refracted by wind and temperature

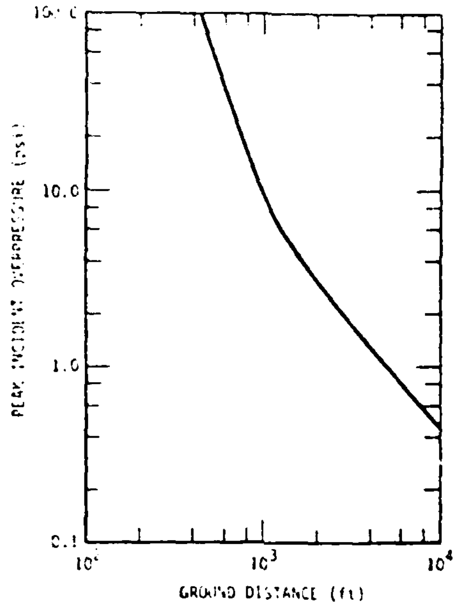

Figure A-1. Close-in airblast predicted for MILL RACE. (Source: Reference A-1)

gradients in the atmosphere. At relatively long distances, airblast can be refracted toward or away from the earth's surface, resulting in increased or decreased overpressures compared with those that would occur in the absence of refraction. Based on theory and a large amount of empirical data, Reed has formulated relationships for estimating the overpressures at long distances from explosions (Reference A-2). For a large chemical explosion on, or near, the ground surface with the airblast propagating through a homogeneous, nonrefracting atmosphere, the incident peak overpressure at long distances is approximately:

$$P_i = 2600\ (W_e)^{0.37}\ R^{-1.1}\ (P/P_o)^{0.63} \qquad \text{(A-1)}$$

where

P_i = incident peak overpressure (Pa) (low overpressures are usually expressed in pascals (Pa), 6894 Pa equals 1 psi or 1 kPa equals 0.145 psi)

W_e = TNT-equivalent weight of the explosion charge (tons)

R = distance from the explosion (thousands of feet)

P = ambient atmospheric pressure at the test site

Large explosions produce an acoustic energy spectrum that is predominantly low frequency at distances of interest, i.e., in the vicinity of 10 Hz or less. The energy content is displaced toward lower frequencies as the size of the explosion is increased. At greater distances, the spectrum is also displaced toward lower frequencies because higher frequencies undergo greater attenuation, and the shock wave loses its impulsive characteristics. At long distances, an explosion sounds like a rumble.

Refracted Atmospheric Propagation

Vertical wind and temperature gradients in the atmosphere can significantly refract airblast at overpressures less than about 0.4 psi. A decrease in temperature with altitude (the usual condition) refracts airblast away from the ground, so that the overpressure at a given ground distance will be less than for the case of no refraction. Conversely, an increase in temperature with altitude, an inversion, refracts airblast toward the ground, thus increasing the overpressure that would be expected at a given ground distance. An increase in wind speed with altitude (the usual condition) refracts the upwind airblast away from the ground and the downwind airblast toward the ground, thus tending to increase downwind overpressures and decrease upwind overpressures. Conversely, decreasing wind speeds with altitude tend to refract upwind airblast toward the ground and downwind airblast away from the ground, thus tending to increase upwind overpressures and decrease downwind overpressures. The combined effects of wind and temperature gradients must be considered when analyzing long-distance propagation of airblast and noise.

The "standard atmosphere" (temperature decreasing with altitude) and no wind corresponds to a "weak" gradient condition; i.e., overpressures will be somewhat less than indicated by the solid line in Figure A-2. With a "strong" gradient, overpressures vary approximately inversely with distance squared.

The meteorological conditions that lead to amplification of long-distance airblast and the relative location and magnitude of such amplification are summarized by Reed from a large amount of data (Reference A-2). The three conditions of concern are boundary-layer ducting, jetstream ducting and focusing, and downwind ozonosphere propagation.

In a temperature inversion, warm air overlies cooler air nearer the ground surface with the result that acoustic waves are trapped and ducted to propagate along the ground. The amplification of overpressure is further enhanced in the downwind direction because of normal downward refraction due to the usual condition of increasing wind speed with altitude. Based on the available data, it appears that inversion/downwind conditions may produce boundary-layer ducting that enhances overpressures by a factor of 2 or 3.

The jet streams, high-speed winds at several tens of thousands feet altitude, can strongly refract acoustic waves back to the earth. Amplification of peak overpressures by an order of magnitude can be expected where such refracted waves are focused back to the earth's surface. Typically, such focusing occurs approximately 40 to 50 miles downwind.

In temperate climates, winds at altitudes of about 30 miles usually blow from east to west in summer and west to east in winter. Since temperature and sound speed at 30 miles altitude are near-surface values, the result is enhanced blast pressures approximately 125 miles downwind and reduced blast pressures upwind from these high-altitude winds. There is a rather low probability of downwind enhancement by a factor of 2 or 3.

As indicated by the above discussion, the long-distance airblast magnitude at any particular point can vary by more than an order of magnitude, depending on the particular meteorological conditions. The dashed lines in Figure A-2 indicate the overpressures from the explosion of 600 tons of ANFO assuming either a strong gradient or upwind condition, amplification by a factor of 3 (ducting or ozonosphere refraction), or amplification by a factor of 10 (jet-stream focusing).

CRATERS AND EJECTA

In contrast to airblast, which is relatively predictable and independent of charge configuration or site location, explosion craters and ejecta strongly depend on charge configuration and the particular geological characteristics of the site and can vary considerably, even for seemingly similar conditions. In this analysis, it will be assumed that the crater dimensions and the ejecta pattern from MILL RACE will be the same as for DICE THROW, which had the same charge size and configuration. (This is a conservative assumption; the crater from MILL RACE should be smaller because the bedded gypsum geology at the MILL RACE site is more cohesive than the alluvium at the DICE THROW site.) The DICE THROW crater was relatively narrow but deep, with an apparent radius of 71.9 feet, an apparent depth of 25 feet, and an apparent volume of 174,813 cubic feet (Reference A-3).

Most crater ejecta is deposited within a few radii of the crater. In DICE THROW, continuous ejecta extended to a radius of about 400 feet (Reference A-3). Figure A-3 shows a fit to the ejecta measurements, in which the ejecta density decreases approximately inversely proportional to the fourth power of the ground distance. In past field tests, few ejecta missiles have been found beyond 3000 feet from GZ.

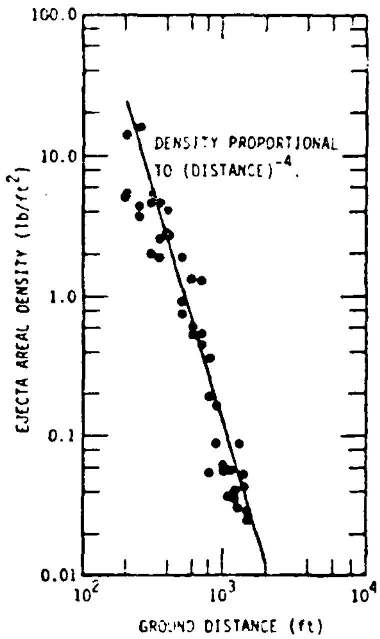

Figure A-3. Ejecta measurements from DICE THROW. (Source: Reference A-4).

GROUND SHOCK

There are relatively few data on ground motion measurements from large high-explosive (HE) field tests at distances of interest for environmental analysis, i.e., where the peak particle velocity is less than a few inches per second. The available data for surface and near-surface HE experiments have been normalized and compared and the analysis indicates that Equation A-3 is a reasonable and conservative assumption for distant ground motions (Reference A-5):

$$V_{max} = 160 \quad R/W^{1/3}\,{}^{-1.4} \qquad \text{(A-3)}$$

where

V_{max} = resultant peak particle velocity (in/sec)
R = ground distance (ft)
W_e = TNT-equivalent weight of charge (lbs).

This ground motion is a Rayleigh wave with a predominant frequency of approximately 6 Hz. For a 600-ton ANFO charge (500-ton TNT-equivalence):

$$V_{max} = 10^5 R^{-1.4} \quad \text{in/sec} \qquad \text{(A-4)}$$

Assuming the fundamental frequency of 6 Hz and simple harmonic motion, the corresponding peak particle acceleration (A_{max}) is:

$$A_{max} = 10^4 R^{-1.4} \quad \text{g's} \qquad \text{(A-5)}$$

Figure A-4 shows Equation A-4 plotted for comparison with the measured peak particle velocities from the 600-ton ANFO charge in DICE THROW. As can be seen, none of the data points exceed Equation A-4, so it will be assumed that peak particle ground motions from MILL RACE will not exceed those obtained from Equations A-4 and A-5.

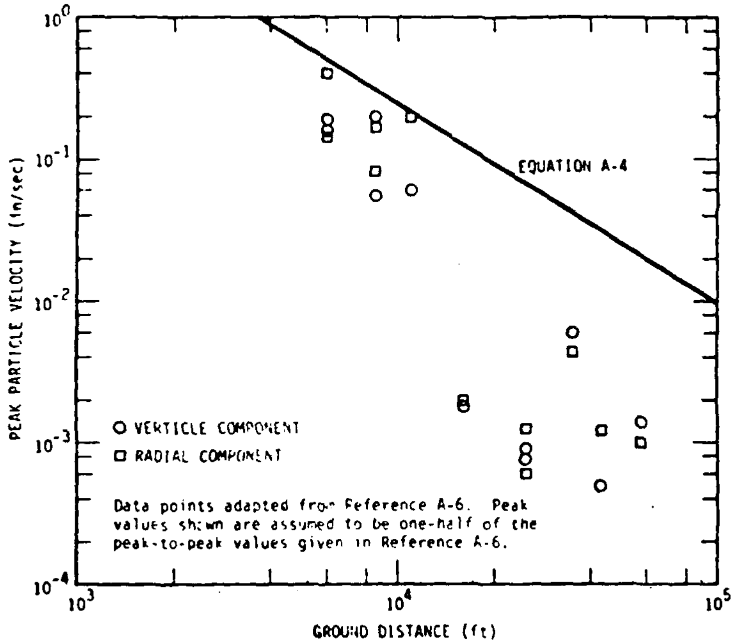

Figure A-4. Peak particle velocity ground motion (Rayleigh wave) from DICE THROW (600-ton ANFO charge) compared to the assumed ground motion equation.

EXPLOSION PRODUCTS

Each explosion will produce numerous chemical compounds, primarily in the gaseous state. Because of oxidation of some of the initial compounds, the weight of the compounds will be greater than the weight of the explosive charge. The best estimate of the types and amounts of chemical species from the explosion of 600 tons of ANFO is shown in Table A-1. (The proportion of fuel oil has been approximately 5.5 percent of the ANFO in past field tests. Between fuel oil contents of 5 and 6 percent, the oxygen balance of the charge shifts, and the proportions of some of the detonation products can vary by several orders of magnitude as shown in Table A-1. Therefore, the assumed amounts of the various chemical species are based on the maximum, for either 5 or 6 percent fuel oil.)

CLOUD RISE AND DIFFUSION

The heat of explosion creates a buoyant fireball of hot gases and earth materials that rises rapidly until it loses buoyancy, continues to expand turbulently until it reaches stabilization dimensions, and then diffuses as it drifts downwind.

The data on clouds from large HE tests are limited to a few 500-ton TNT explosions and one 100-ton explosion, as discussed in Reference A-5. Based on these limited data, a 500-ton TNT-equivalent charge of high explosive exploded on the ground surface will produce a roughly cylindrical cloud that is approximately 10,000 feet high, approximately 5000 feet thick in the vertical direction, and with a diameter of about 5000 feet at the time of stabilization (after about 15 minutes). For these dimensions, the volume at the time of stabilization will be approximately 10^{11} cubic feet.

Most of the earth materials in such a cloud fall back to earth in the vicinity of the crater. Only a small fraction of particulate matter is light enough to remain in the cloud and be transported by diffusion downwind with the gaseous detonation products. Based on dust samples collected from the DIAL PACK cloud by aircraft, the average dust concentration at the time the cloud stabilized (about 15 minutes after the explosion) was approximately 0.004 g/m^3 and the concentration decreased inversely with time to the 1.4 power over the measurement period of from 10 minutes to 60 minutes following the explosion; that is, for each ten-fold increase in time, the dust concentration decreased by a factor of 25 (Reference A-8). Based on the approximate cloud dimensions of a vertical thickness of 5000 feet and a horizontal diameter of 10,000 feet (the DIAL PACK cloud was unusually large horizontally) and the apparent crater volume of 260,000 cubic feet, approximately 1.7 percent of the crater volume was in the DIAL PACK explosion cloud at the time of cloud stabilization.* Since

*This percentage might vary considerably for any particular test, but DIAL PACK is the only field test where cloud dust concentrations have been measured. Any higher percentage in the MILL RACE cloud should be offset by the fact that the volume of the MILL RACE crater should be less than the value assumed.

Table A-1. Predicted detonation products from a 600-ton ANFO charge.

Chemical specie		moles/kg[a]		Percent by weight[b]	Amount of detonation products (lbs)[b]
Name	Symbol	5% FO	6% FO		
Water	H_2O	27.2	27.4	49.0	500,000
Nitrogen	N_2	11.6	11.7	32.8	300,000
Carbon dioxide	CO_2	3.53	3.53	15.5	190,000
Carbon monoxide	CO	0.046	0.761	2.1	25,000
Nitric oxide	NO	0.578	0.053	1.7	20,500
Oxygen	O_2	0.340	0.002	1.0	12,000
Ammonia	NH_3	8×10^{-4}	0.050	0.085	1,000
Hydrogen	H_2	0.016	0.253	0.05	600
Nitrogen dioxide	NO_2	0.007	5×10^{-5}	0.0322	390
Hydroxide radical	OH	0.017	0.006	0.0289	350
Nitrous oxide	N_2O	0.003	3×10^{-4}	0.0132	160
Hydrogen cyanide	HCN	2×10^{-6}	0.002	0.0054	65
Oxygen radical	O	0.002	2×10^{-4}	0.0032	40
Methane	CH_4	0	2×10^{-5}	$3.2(10^{-4})$	4

Notes:

[a]Source: Reference A-7.

[b]Based on the maximum for either 5 percent or 6 percent fuel oil (FO).

the soil materials at the DIAL PACK site (a layer of silty clay over a layer of fine silty sand) are expected to be of comparable size, or less, with those at the proposed MILL RACE test site, assuming 1.7 percent of the crater volume in the cloud at stabilization for the proposed test is reasonable and conservative. Based on this assumption, for the conservatively estimated crater volume of 175,000 cubic feet and an average weight of 100 pounds per cubic foot for dry earth materials, the explosion cloud at stabilization will contain approximately 135 metric tons of dust for transport by diffusion.

As the explosion cloud drifts downwind, it diffuses and the concentrations of dust and detonation products decrease while the edge of the cloud approaches ground level. At a certain distance downwind, which is a function of the initial height and dimensions of the cloud and the rates of diffusion in the horizontal and vertical directions, the ground-level exposure from this cloud will reach a maximum; at closer distances, the cloud has not diffused to ground level and at greater distances, the horizontal diffusion dominates to reduce the exposure below the maximum. It is believed that no measurements of maximum ground-level concentrations of explosion cloud products from large explosions have ever been taken. Since the location of the maximum concentration would vary over great distances depending on meteorology and the predicted concentration is typically very dilute, it seems impractical to attempt such measurements. To estimate the maximum downwind concentrations and their location, it is necessary to rely on theory that is based on empirical data. Since the results from these theoretical calculations can vary considerably from the actual result, it is prudent to use conservative assumptions.

The estimated exposure at ground level directly downwind from the explosion cloud can be calculated from Equation A-6, which has been adapted from Reference A-9:

$$E = \frac{\sigma_x \sigma_y \sigma}{\sigma_x \sigma_y \sigma_z + V_i} \times \frac{Q}{\pi \sigma_y \sigma_z \bar{u}} \exp \left\{ - \frac{h^2}{2\sigma_z^2} \right\} \qquad \text{(A-6)}$$

where

E = exposure ($g \cdot sec/m^3$)

σ_x = standard deviation of the distribution of material in the cloud in the horizontal downwind direction (m)

σ_y = standard deviation of the distribution of material in the cloud in the horizontal crosswind direction (m)

σ_z = standard deviation of the distribution of material in the cloud in the vertical direction (m)

V_i = volume of the initial cloud, i.e., at stabilization (m^3)

Q = total mass of the material of concern in the cloud (g)

$\bar{u}$ = average wind speed (m/sec)

h = height of point of release, i.e., height to center of the initially stabilized cloud (m).

The standard deviations in Equation A-6 are functions of the meteorological conditions and the distance of travel of the cloud. Based on the recommended values in Reference A-10 for an unstable atmosphere* (extrapolated to greater distances in some cases), the exposure at various distances downwind from the predicted explosion cloud was calculated. The calculations indicate that the maximum exposure at ground level will be approximately:

$$E_{max} = 8 \times 10^{-8}\, Q/\bar{u} \quad g{\cdot}sec/m^3 \tag{A-7}$$

and will occur approximately 75 miles downwind. Assuming a relatively slow wind speed of 2 m/sec (a conservative assumption because slow wind speeds increase exposure), the maximum exposure would be:

$$E_{max} = 4 \times 10^{-8}\, Q \quad g{\cdot}sec/m^3 \tag{A-8}$$

Based on the estimate of 135 metric tons of dust in the explosion cloud, the maximum exposure downwind will be 5.4 $g{\cdot}sec/m^3$, or 60 $\mu g/m^3$, when averaged over a 24-hour time period. The average concentrations of other gaseous detonation products will be proportional to their weights as given in Table A-1. However, the sum of the weights of all the products that might be considered air pollutants (i.e., all except water, oxygen, nitrogen, and carbon dioxide) total only about 22 metric tons, equivalent to an exposure of only about 10 $\mu g/m^3$ when averaged over 24 hours.

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*An unstable atmosphere is one with a relatively large amount of vertical mixing. Ground-level exposure estimations that assume an unstable atmosphere are conservative in that this meteorological condition produces the highest level of ground-level exposure. An unstable atmosphere is also the most deliverable condition for a large HE field test because there is less likelihood for ducting of airblast.

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MILL RACE DAMAGE ASSESSMENT OF STRUCTURES AT THE MC DONALD RANCH

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Technical Note

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This report documents an analysis of the potential for damage to structures at the McDonald Ranch, part of a national historic site, when exposed to airblast and ground shock from the proposed MILL RACE high-explosive field test. This report is in support of the Environmental Assessment for MILL RACE. The analysis indicates that it is unlikely that any of the structures will suffer significant structural damage.

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PREFACE

DNA proposes to conduct MILL RACE, a high-explosive field test, in the northern portion of the White Sands Missile Range (WSMR) in September 1981. A 600-ton charge of ANFO high-explosive is planned for MILL RACE, to simulate the blast and shock from a 1-kt nuclear surface burst. An Environmental Assessment (EA) is being prepared for the MILL RACE program.

The site proposed for MILL RACE is located approximately 12,000 feet south of McDonald Ranch, which is comprised of an abandoned ranchhouse and some other structures. Although the ranch structures are in a deteriorated condition, the McDonald Ranch is part of the Trinity national historic site (the ranchouse was where Trinity, the first nuclear test device, was assembled) and therefore requires special consideration in the Environmental Assessment to ensure that any possible effects from the MILL RACE program are fully analyzed.

The McDonald Ranch structures are at a distance where airblast and ground shock would not normally be expected to cause other than cosmetic damage. Because of the deteriorated condition of the structures, however, and the fact that they comprise a historic site, DNA decided that a structural survey and analysis of the ranch structures should be performed. General Electric-TEMPO, responsible for preparing the EA, retained Dr. Thomas L. Paez, an assistant professor in the Department of Civil Engineering at the University of New Mexico, to visit the McDonald Ranch, survey the structures, and assess the potential for blast and shock damage from MILL RACE. The findings of Dr. Paez are contained in the remainder of this report. His general conclusion is that there is a low probability of MILL RACE causing substantial structural damage to the McDonald Ranch structures.

MILL RACE DAMAGE ASSESSMENT
OF STRUCTURES AT THE MCDONALD RANCH

Introduction

The McDonald Ranch is located in the northern region of the White Sands Missile Range (WSMR), approximately 40 miles from Socorro, New Mexico. A map showing the approximate location of the McDonald Ranch relative to other sites on the WSMR is given in Figure 1. Located at the McDonald Ranch are five structures in various physical conditions. The approximate relative locations of the five structures are shown in the sketch of Figure 2.

The main structure is the ranch house, and this includes five main rooms. Of the five structures, this one remains in the best physical condition. Yet, the condition of this building is quite poor. The structure has approximate outside dimensions of 30 feet by 45 feet. It is built on a rock foundation which appears to be in good condition. The foundation is approximately 24 inches wide. In the main part of the structure, the walls are constructed from adobe, covered with plaster. The walls are constructed from adobe and rock, in the remainder of the structure. Specifically, the core of the wall is adobe and this is faced with rock. All the walls on this structure are approximately 18 inches thick. Exterior window openings exist in all rooms, but there is no window glass in the building.

The floors in the ranch house building are constructed from wood and appear to rest on a wood frame; these are in poor condition throughout the house. The interior walls in the structure are constructed from adobe bricks covered with plaster; in most places these are 18 inches thick. In some places, the interior walls are damaged. For example, the upper portion of the interior wall dividing the two rooms at the south end of the house has collapsed, and the wood lintel above the doorway connecting these two rooms is damaged.

The ceiling in all rooms appears to be sheetrock attached to a lightweight wood lattice; it is in very poor condition throughout the house. In some places the sheetrock is attached to the wood lattice; in some places it has fallen to the floor; in other places the sheetrock has become partially detached and hangs from the ceiling.

In the five main rooms of the ranch house six frames have been installed. The purpose of these frames is to help prevent collapse of the ceiling. The frames are built from wood 4x4's, and consists of a horizontal member butted against the ceiling and supported by two vertical members. Each room has at least one frame.

The roof of the ranch house structure is built on a frame of rough sawed 2x6 wood members. On top of this rests a deck of rough sawed 1x6 wood members. On top of the deck lies a corrugated metal covering. The thickness of the metal appears to be about

1/16 inch. The wood appears to be [illegible] condition in those places where roof failure has not occurred. The 2x6 w[illegible]vide most of the strength for the roof. Most of the 2x6 wood members suppor[illegible] on the north side of the building have been fractured. The reason for this ap[illegible] be excessive external roof load. Several of the 2x6 wood members supporting the roof on the west side of the main structure have been fractured. The probable reason for this is the same as above. In places where roof members fractured and the roof collapsed, the support structure has been repaired by placing vertical 2x4 wood members between each fractured member and the wood roof framework below it. It is likely that roof damage occurred as a result of the 19 kiloton test at the Trinity site which is located about 12,000 feet from the McDonald Ranch.

A second structure on the ranch appears to be a barn. This structure has plan dimensions of about 36 feet by 60 feet. This structure is supported on a rock foundation and has walls constructed from adobe and rock. Specifically, the walls consist of an adobe core faced with rock. The walls of this structure are about 14 inches thick. Interior and exterior walls are constructed the same. The top portion of the walls has collapsed in several places. This structure has no roof.

A third structure on the ranch appears to have been a living quarters. This structure is located north of the barn and is in poor condition. The plan dimensions of this structure are about 20 feet by 25 feet. This structure is supported on a rock foundation and has walls constructed from adobe faced with rock. The interior and exterior walls of the structure are about 14 inches thick. Over most of the structure the top portion of the wall has collapsed, and in some places, most of the wall has collapsed. The structure has no roof.

The fourth structure on the ranch is a wooden truss which once supported a windmill. The structure appears to be in good condition. The structural joints appear to be tight. The four corner members have cross sections measuring 8 inches by 6½ inches. The horizontal cross members have cross sections measuring 5 inches by 5 inches. The diagonal cross members have cross sections measuring 2 inches by 6 inches. The corner posts attach at the bottom to wood members which are embedded in the soil, and extend above the soil surface about two feet. These supports have cross sections measuring 8 inches by 6½ inches. The windmill is no longer attached to the truss, therefore, the truss is only required to support its own weight.

The fifth structure on the McDonald Ranch is a water storage reservoir. This reservoir has two compartments. Its depth is about six feet. The structure is built so that about half its height is below ground level, and the other half above. The walls are constructed from concrete, and are about 10 inches thick.

Plans have been made to stage a high explosive field test, called MILL RACE, on the WSMR in the near vicinity of the McDonald Ranch. The tentative location of the test is indicated on the map of Figure 1. The location is approximately 12,000 feet south of the McDonald Ranch. There is a low rise in the ground surface between the test site and the McDonald Ranch. The charge for the high-explosive test is planned to be 600 tons of ammonium nitrate and fuel oil (ANFO). This is equivalent to 500 tons of TNT or a 1 kiloton nuclear explosion.

The McDonald Ranch has an historical significance because of its proximity to the Trinity test site and its connection with that test. Therefore, it is desirable to protect it from damage caused by the MILL RACE test. As a result of this test, damage could occur to the McDonald Ranch structures due to airblast overpressure and/or ground motion excited by the explosion.

It is the purpose of this report to summarize approximate calculations revealing the likelihood that structural damage will occur to any of the McDonald Ranch buildings as a result of the MILL RACE test.

Structural Analysis

In a letter dated 1 October 1980, sent by Mr. Kenneth E. Gould of General Electric, Tempo, and addressed to Tom Paez (1)* it is indicated that the anticipated airblast overpressure at the McDonald Ranch caused by the MILL RACE explosion is 0.35 psi peak incident and 0.70 psi peak reflected. This estimate is based on predicted and measured overpressures from DICE THROW, a high-explosive charge of tne same size and configuration as MILL RACE that was located only 5 miles from the proposed MILL RACE site. The anticipated positive phase duration is less than one second. Further, it is indicated in that letter that the estimated peak particle velocity associated with Rayleigh wave ground motion would not exceed 0.2 inches/second, based on DICE THROW and other results. The fundamental frequency of this motion is estimated at 6 hertz.

Because of the poor physical condition of most of the structures on the McDonald Ranch, and the fact that they are constructed from inelastic structural materials it is difficult to determine the likelihood of structural collapse, or any other specific structural response. In spite of this it is possible to perform some relatively simple computations which provide an indication of the likelihood of structural failure. The computation performed first, below, is probably the most accurate and most important.

It was mentioned in the Introduction that portions of the roof on the main ranch house structure have been collapsed due to the application of excessive external load. Specifically, most of the external roof structural members on the north side and some of those on the west side are fractured near their centers. It may be assumed that this damage is a result of airblast overpressure generated during the Trinity test, since the Trinity test site is northwest of the McDonald Ranch. In the following, the approximate

* Numbers in parentheses refer to a list of references attached to this report.

airblast overpressure at the McDonald Ranch associated with the Trinity test will be calculated. And the estimated shock required to cause failure of the ranch house roof will be estimated. These figures will provide an estimate of the input required to cause roof failure, and they will also provide information on the excitation which the walls of the remaining structures were able to survive.

The distance of the Trinity test site from the McDonald Ranch is about 12,000 feet and the Trinity test had a yield of about 19 kilotons. Scaling the DICE THROW overpressure vs. range curve indicates that the peak overpressure from Trinity was about 1.15 psi, and the peak reflected overpressure was 2.3 psi. The peak reflected overpressure caused roof failure, and the walls at the McDonald Ranch which survive today survived the overpressure shock. Therefore, it may be assumed that the roof failure load threshold is somewhat less than 2.3 psi, and the wall failure load threshold is greater than 2.3 psi.

Two analyses are presented in the following. These attempt to confirm the failure threshold levels estimated in the previous paragraph. In order to establish an approximate time history for the pressure pulse caused by the Trinity test it will be assumed that the peak reflected overpressure was 2.3 psi. Then Figure 3.5 in Reference 2 shows that the time of arrival of the pressure shock, t_a, was approximately 3 seconds. Figure 3.5 and Equation 3.4 in Reference 2 indicate the pressure time history was approximately

$$p\ (t) = 2.3\ (1-\tau)e^{-0.28\tau} \qquad \tau \geq o \qquad (1)$$

$$\tau = \frac{t^* - t_a}{t_o} = \frac{t}{t_o}$$

where t^* is the time after detonation, with $t = t^* - t_a$. In order to simplify the analyses to follow, the pressure time pulse is approximated using the function

$$p\ (t) = 2.3\ e^{-1.69\tau} \qquad \tau \geq o \qquad (2)$$

This approximation was established by finding the best fit of $(1 - \tau)e^{-0.28\tau}$ by $e^{-\alpha\tau}$, in a least squares sense. This approximation is quite accurate, especially in the range $\tau < 0.8$.

The first structural element to be considered is the wood roof member. The wood roof members are placed on two foot centers, and are, approximately, simply supported at their ends. Therefore, the structural model shown in Figure 3 can be used as an idealization.

The beam parameters are mass per unit length, $m = 0.0036$ lb-sec^2/in^4, (This considers mass of the wood 2x6, wood deck, and corrugated steel cover.) modulus of elasticity,

$E = 1.76 \times 10^6$ psi, length, l = 151 inches, and moment of inertia, $I = 27.7$ in^4 (Actual cross sectional dimensions are 2 inches x 5.5 inches.) The failure strength of wood, σ_{max}, is assumed to be, approximately, 2000 psi.

The equation of motion governing the beam of Figure 3 is given, for example, in Reference 3. This equation of motion can be reduced to the equation of motion for a single-degree-of-freedom, (SDF) system, and the approximate motion of the structure in its first mode will be predicted. This reduction can be accomplished using a method presented in Reference 3, and the equation of motion is

$$m^* \ddot{\zeta} + k^* \zeta = p^* e^{-\alpha t} \tag{3}$$

where $m^* = ml/2$

$k^* = \pi^2 EI/2l^2$

$p^* = \frac{2l}{\pi} p_o$

α = 5.63 (the load decay rate computed from Equation 2)

p_o is the load per unit length of the beam which will cause failure; this is to be computed. $\zeta(t)$ is the deflection at the center of the beam, and dots denote differentiation with respect to time. In reducing the equation of motion for the beam to Equation 3, it has been assumed that the beam takes the shape given by

$$\psi(x) = \zeta \sin \frac{\pi x}{l} \qquad 0 \leq x \leq l \tag{4}$$

Equation 3 can be reduced to standard form by dividing both sides by m^*. The result is

$$\ddot{\zeta} + 2 \zeta w_n \dot{\zeta} + w_n^2 \zeta = \frac{p^*}{m^*} e^{-\alpha t} \tag{5}$$

where $w_n^2 = \frac{k^*}{m^*}$

and a damping term has been added. It will be assumed in this analysis that the damping, ζ, is five percent.

The solution to Equation 4 can be obtained by writing the convolution integral for the system and solving it. This yields,

$$\zeta(t) = \frac{P^*}{m^* (\alpha^2 - 2\alpha\zeta w_n + w_n^2)} \left\{ e^{-\alpha t} + e^{-\zeta w_n t} \left(\frac{\alpha - \zeta w_n}{w_d} \sin w_d t - \cos w_d t \right) \right\} \qquad t \geq o \tag{6}$$

where $w_d = w_n \sqrt{1-\zeta^2}$.
The peak value of response, $\zeta(t)$, occurs near $t = \pi/w_n$.
The peak value of response is

$$\zeta_{max} = 0.0167 \quad p_o \tag{7}$$

Since the value of roof load, p_o, which brings the roof to the failure threshold is sought, the beam center deflection which brings the roof to the failure threshold can be determined, and this can be equated to Equation 7, and p_o can be determined. The moment which is realized at the beam center when $\zeta(t) = \zeta_{max}$, can be determined by differentiating Equation 4, twice with respect to x, setting $x = l/2$, multiplying by EI, and setting $\zeta = \zeta_{max}$.

$$M = EL \; \zeta_{max} \left(\frac{\pi}{l}\right)^2 \tag{8}$$

where M is moment at the beam center. (This is true because of Bernoulli's beam relation, Reference 3.)
The moment stress relation is

$$M = \frac{\sigma I}{c} \tag{9}$$

where c is the half depth of the beam. (See, for example, Reference 4.)
Equate the right hand side of Equations 8 and 9, and solve for ζ_{max} to obtain

$$\zeta_{max} = \frac{\sigma}{EC} \left(\frac{l}{\pi}\right)^2 \tag{10}$$

To determine the beam load that causes failure, set $\sigma = \sigma_{failure} = 2000$ psi, and equate the right hand sides of Equations 7 and 10.
This yields

$$p_o = 57.2 \text{ lb/in.} \tag{11}$$

Since each roof member supports a two foot width of roof, the external pressure which causes failure is

$$P_o = \frac{57.2}{24} = 2.38 \text{ psi} \tag{12}$$

This estimate agrees very well with previous computations which showed that the failure load threshold for the roof was somewhat less than 2.3 psi. Since the dynamic character of the response of the roof, excited by the pressure shock from the MILL RACE test will not be significantly different from the response excited by the Trinity test, and since the peak overpressure in the MILL RACE test will be about one-third that from the Trinity test, it can be concluded the MILL RACE test will cause no roof damage.

The second analysis to be summarized in this report is one which assesses the likelihood of survival of the wall structures at the McDonald Ranch. The walls of most of the structures are free standing, i.e., not supported at the top by roof framework. The external walls of the main ranch house are supported by a roof framework and by internal walls. Moreover, these walls are the most massive (19 inches thick). In view of this the free standing walls which are 14 inches thick are more likely to fail, and these will be considered in the present analysis. Many of the walls at the McDonald Ranch face directly south (the direction of the MILL RACE test), and a cross section of a typical wall is shown in Figure 4.

The pressure load at a point has the form given in Reference 2. The specific reflected overpressure load at a point 12,000 feet from the MILL RACE test will be

$$p(t) = P_o e^{-1.52t} \qquad t \geq o \tag{13}$$

where P_o is the peak reflected overpressure, and will be about 0.70 psi. It is assumed that the positive phase duration will be approximately one second. The decay rate, 1.52, was derived using the least squares approach mentioned previously.

To determine how load will be applied to a wall it must be noted that the pressure wave front will be traveling at a speed of approximately 1100 feet per second when it reaches the McDonald Ranch. (See Equation 3.5 in Reference 2.) When the pressure wave reaches a south-facing wall, the wall is loaded almost instantaneously. The pressure wave rapidly engulfs the wall, and after a short time period corresponding to the engulfment time, the initial pressure wave is, for all practical purposes, cancelled by the opposing pressure on the rear side of the wall. The engulfment time is about T/1100 seconds, where T is the wall thickness in feet. As a result of this loading sequence, the input pressure load shown in Figure 4 resembles a temporal impulse load. In the analysis of the walls it is reasonable to assume, first, that the walls possess some bending strength which arises from material cohesion, and, second, that the walls possess a shear strength which is greater than that resistance which arises from the combined effects of friction and gravity. It would be very conservative to assume, first, that overturning of the wall is prevented merely by the effects of gravity, and second, that shear failure is prevented merely by the effects of gravity and friction. In the present analysis, the latter two assumptions are used. A unit width of the wall is analyzed to determine whether overturning or shear failure will occur.

An overturning model for the wall is shown in Figure 4. The initial velocity imparted to the center of gravity of the wall is given by the integral

$$v_o = \int_o^{\Delta t} \frac{p(t)\ h}{m}\ dt \tag{14}$$

where t = T/1100
T = wall thickness
h = wall height
m = mass of unit width of wall
$P(t)$ = pressure from Equation 13.

Since $\Delta t \ll 1$, this integral can be evaluated, approximately, as

$$v_o = \frac{p_o\ h\Delta t}{m} \tag{15}$$

The kinetic energy of the wall excited by the pressure impulse is

$$K_e = \frac{mv^2}{2} = \frac{(p_o\ h\Delta t)^2}{2m} \tag{16}$$

As the wall rotates about the pivot (on the lower right), the center of gravity moves upward and the kinetic energy is converted to potential energy. The potential energy stored in a unit width of wall as the angle between the horizontal and the line between the center of gravity and the pivot changes from α to β is

$$P_e = \frac{mg}{2} \sqrt{h^2 + T^2}\ (\sin \beta - \sin \alpha) \tag{17}$$

The angle α at which the structure ceases moving can be determined by equating the right hand sides of Equations 16 and 17 and solving for β.

In the present case, it is conservative to use in this analysis the values

P_o = 0.7 psi
h = 96 in

$t = 0.0011$ sec.

$T = 14$ inches

$m = 0.30$ lb-sec^2/in (based on wall weight density of 150 lb/ft^3)

$\alpha = 81.7029°$

The angle β is found to be

$$\beta = 81.7035° \tag{18}$$

Clearly, the wall barely moves, and failure in overturning is not possible.

A shear model for the wall is shown in Figure 4. A unit width of wall will be considered. The total lateral force applied to the unit width of wall is

$$F = p(t)\ h \tag{19}$$

The resistance to shear motion which results from the effects of gravity and friction is

$$F_R = Th\gamma\mu \tag{20}$$

where $\gamma = 0.0868$ lb/in (wall material weight density)

$\mu = 0.40$ (wall material coefficient of friction)

(Though the structural material has not been tested, this value for μ is considered reasonable.)

Where F_R is greater than F, shear motion of the wall will be prevented. Using Equations 19 and 20, it is possible to show that when $F_R > F$, then

$$p(t) < T\gamma\mu \tag{21}$$

Motion of the structure will not commence as long as this inequality is satisfied. Noting that the wall thickness is 14 inches reduces the inequality to

$$p(t) < 0.49 \text{ psi} \tag{22}$$

The peak value of p(t) will be approximately 0.70 psi. Because of the conservatism inherent in the present analysis, i.e., the assumption that shear motion is resisted only by the effects of gravity and friction, it is unlikely that shear motion will ever commence. If shear motion did commence, it would have very small displacements associated with it since the pressure pulse duration is very short.

A third structural analysis which might be pursued, at this point, is the analysis of the windmill support truss. This structure is in such good condition, though, that analysis would certainly reveal that the truss can survive the load excited by the MILL RACE test.

A less severe form of structural loading, than that discussed in the above analyses, is the load arising from ground motion. It has been estimated in Reference 1 that the peak particle velocity associated with Rayleigh wave ground motion is less than 2 in. per second. The fundamental frequency of this motion is 6 hertz. The realization of the velocity wave described above indicates that a peak displacement of less than 0.005 inches will occur, and a peak acceleration of less than 0.02 g will occur. This base motion is far too small to cause any structural damage in any of the buildings of the McDonald Ranch.

Conclusions

The calculations and discussions presented in this report show that the likelihood is very small that structural damage will be caused by the MILL RACE test. Structures and portions of structures which exist today at the McDonald Ranch survived the Trinity test, and that test had a peak reflected overpressure of about 2.3 psi. The MILL RACE test will generate a peak reflected overpressure of about 0.70 psi.

The individual calculations presented above indicate a high probability that no substantial structural damage will occur to any structure due to the MILL RACE test. However, in some places nonstructural components are very weak and these may be damaged. For example, some of the ceiling sheetrock in the ranch house structure which is partially detached from the ceiling may completely detach. Loose stones which lie on top of some damaged walls may fall.

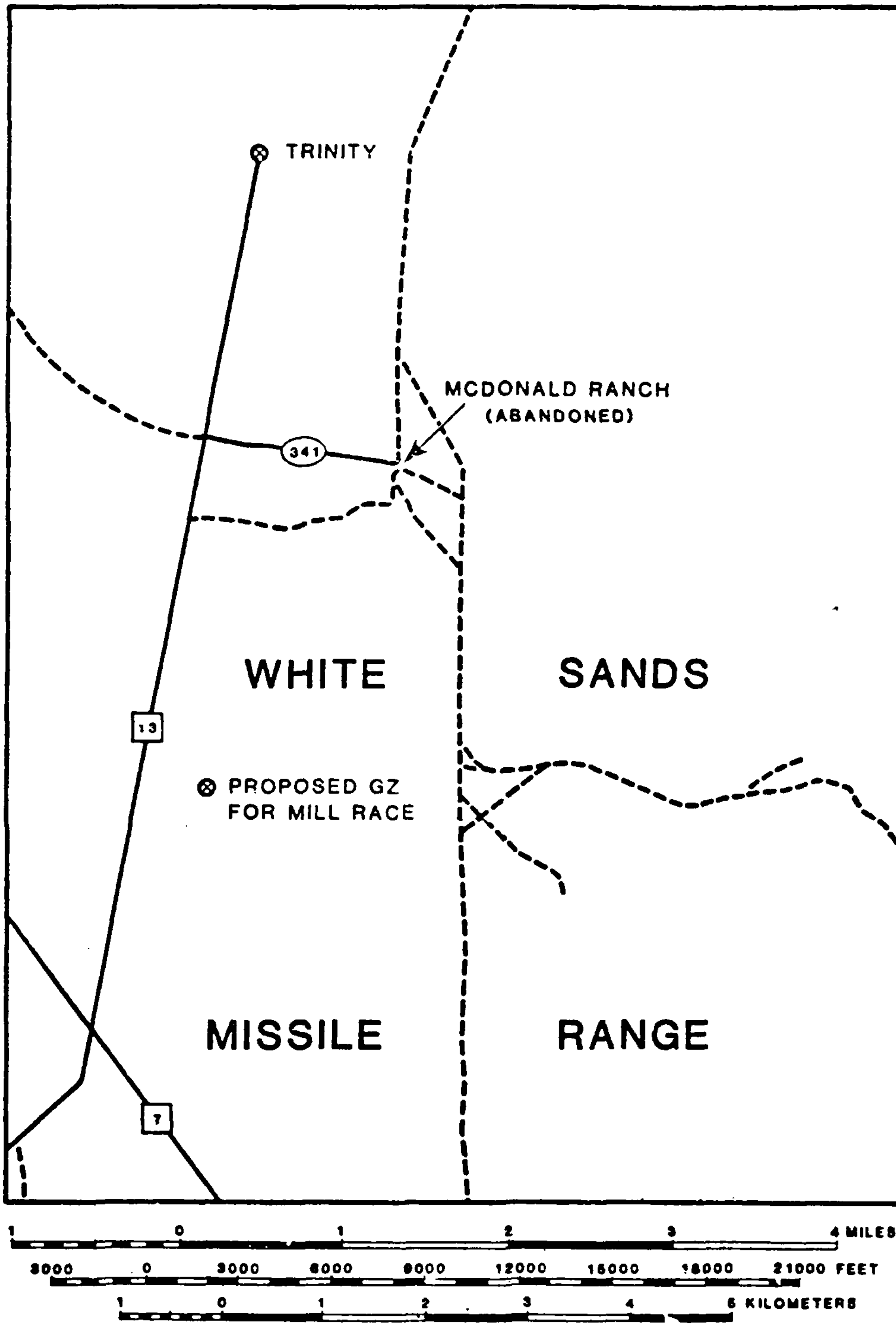

Figure 1. Vicinity of McDonald Ranch.

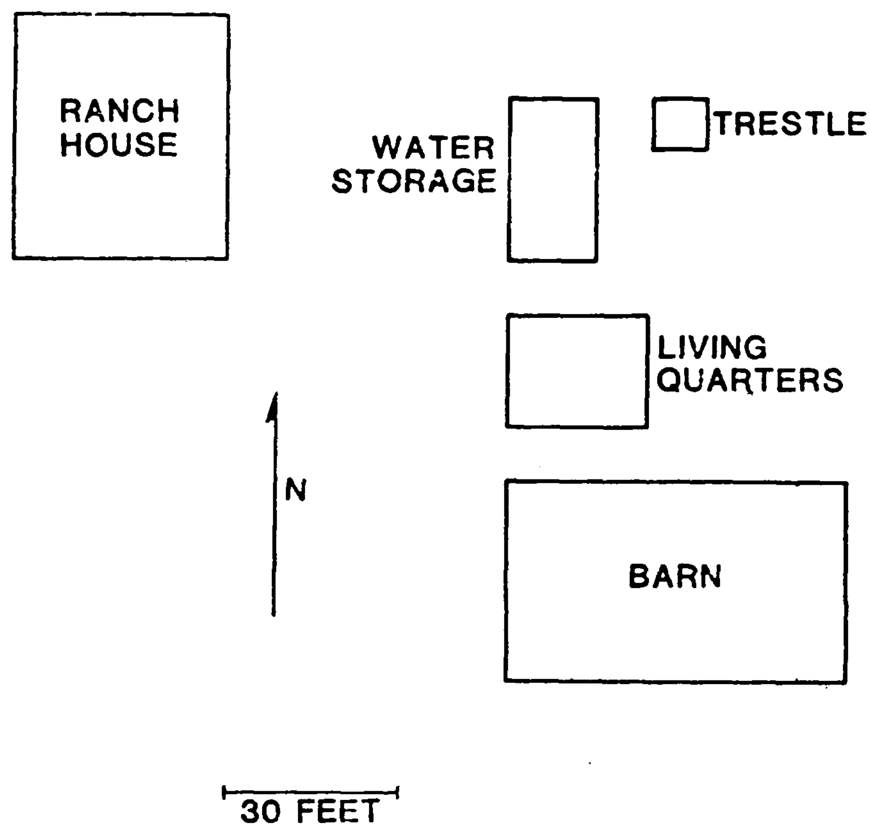

Figure 2. Map showing approximate relative locations of structures at the McDonald Ranch.

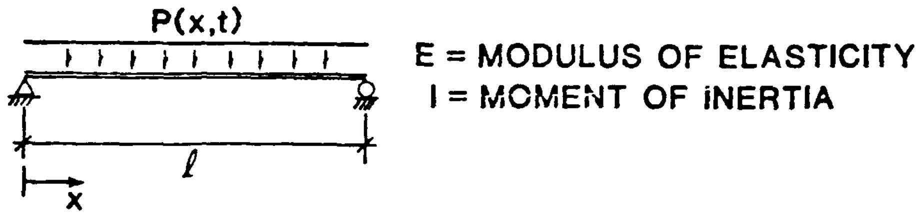

Figure 3. Beam.

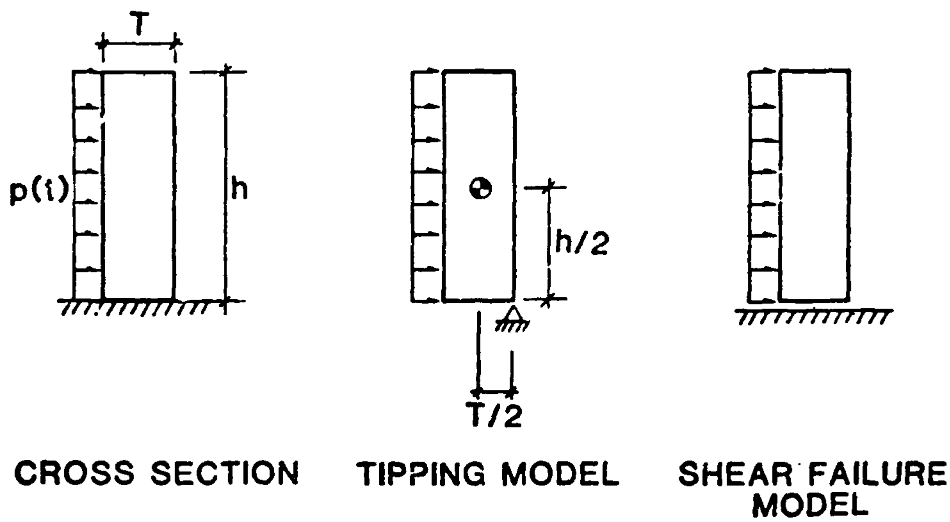

Figure 4. Wall cross section and models.

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APPENDIX E-3

AN ARCHAEOLOGICAL SURVEY OF THE MILL RACE PROJECT, SOCORRO COUNTY, NEW MEXICO

Karl W. Laumbach

with a contribution by
Toni Sudar Laumbach

Performed under purchase order number DAAD07-81-M-7685

A REPORT PREPARED FOR THE UNITED STATES ARMY, WHITE SANDS MISSILE RANGE, under the direction of Patrick H. Beckett of the Cultural Resources Management Division, Department of Sociology and Anthropology, New Mexico State University, Las Cruces.

March 1981

Report No. 439

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INTRODUCTION

From November 18 through November 24, 1980, personnel from the Cultural Resources Management Division, Department of Sociology and Anthropology, New Mexico State University, Las Cruces, performed an archaeological clearance survey of 1789 acres on White Sands Missile Range in southcentral New Mexico (Figure 1). Karl W. Laumbach directed the field work, and was assisted by Kira Silverbird, Glenda Hilley, and Bill Bloch. The survey was conducted at the request of Mr. Albert Johnson of the Office of Facility Engineering, White Sands Missile Range. Work was performed under a contract between the United States Army, White Sands Missile Range and the Regents of New Mexico State University under Purchase Order Number DAAD07-81-M-7685.

The purpose of the survey was to identify, evaluate, and catalogue cultural resources present within the 1789-acre project area. All work was performed in accordance with the U.S. Army's Historic Preservation guidelines AR 200-1 and TM-5-801-1. In addition to a physical description of archaeological and historical sites present, three statements concerning the cultural resources were required by the contract:

A statement of the potential archaeological or historical significance of each site;

A recommendation for the collection, testing, or excavation of each site based on the statements of significance;

An objective statement of potential impact on the cultural resources considering adverse effects resulting from planned construction and other activities.

Figure 1. Location of White Sands Missile Range
■ = MILL RACE project location.

THE SURVEY AREA

The survey area is located in the northeastern area of the White Sands Missile Range (Figure 1). The project is on the southwestern side of the Oscura Mountains and 3 miles northwest of Mockingbird Gap. The southern corner of the trapezoidal figure is at the intersection of Range Road 7 and Range Road 13. Portions of Sections 1, 10, 11, 12, 13, 14, 23, and 24, Township 8 South, Range 4 East, and a portion of Section 18, Township 8 South, Range 5 East are included in the project area (Figure 2).

PHYSIOGRAPHIC LOCATION

The gently sloping terrain of the project area drains the southeastern slopes of the Oscura Mountain Range. Technically part of the Rio Grande drainage system, it is doubtful if much water makes it through the rolling sandy desert that separates the project area from the Rio Grande, some 30 miles to the west. Six miles to the east, the cliffs of the Oscuras create an imposing escarpment. South of there, Mockingbird Gap opens the door to the Tularosa Basin, an entrance immediately constricted by the San Andres Range to the south. The pinon-covered western slopes of the Chupadero Mesa are visible many miles to the north.

SOILS

The soils of the project area are assigned to the Berino-Dona Ana association (Neher and Bailey 1976:5-6). These soils are deep and well-drained, consisting of sandy loam formed in alluvial sediments. Because of the alluvial action, many areas are eroded to the caliche or down to accumulations of log gravels. The lag gravels consist mainly of

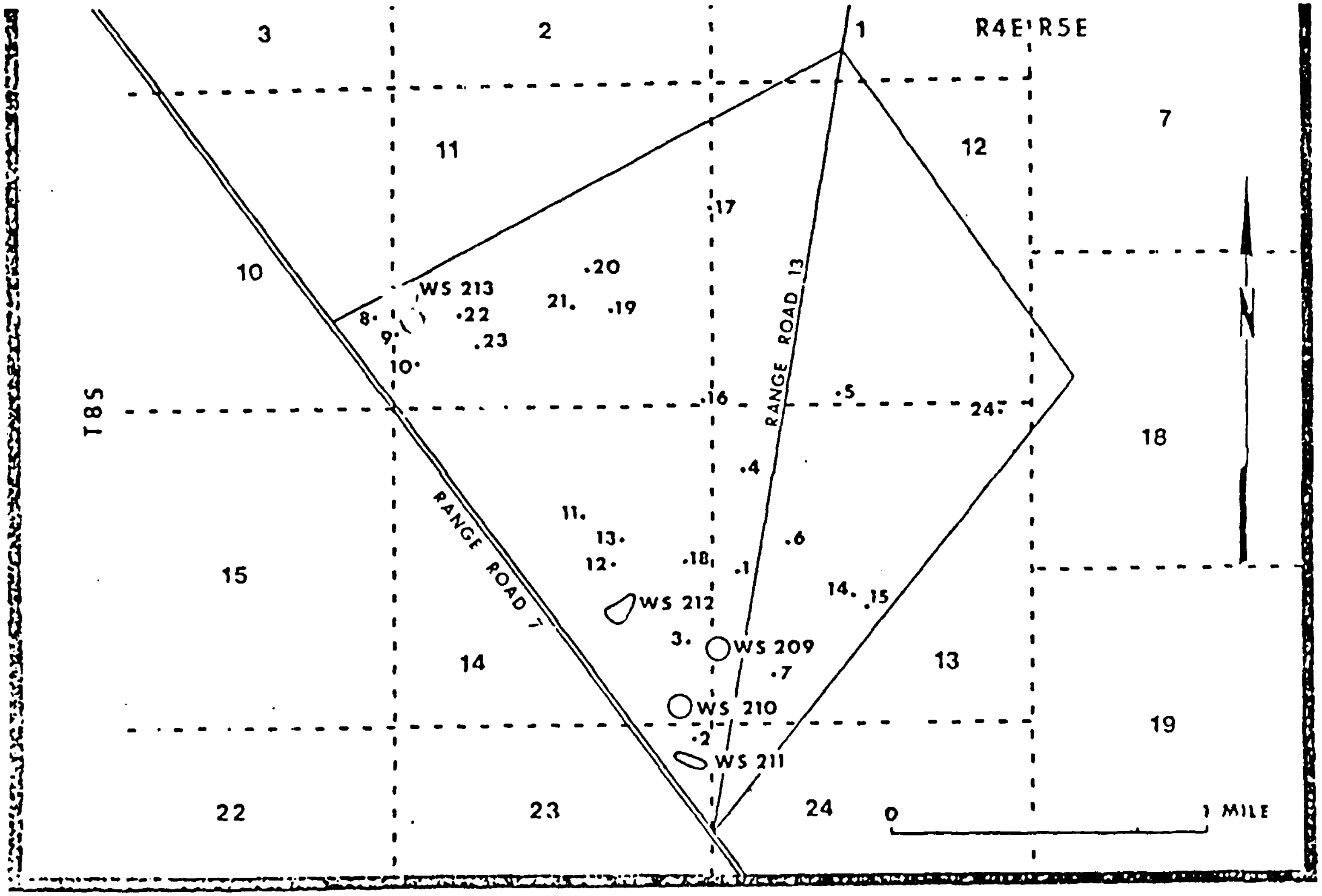


Figure 2. MILL RACE project location, location of sites and isolated occurrences.

angular chert and limestone nodules originating in the Oscuras. In the Mill Race area the developed Berino-Dona Ana soils are on the ridges and rolling plains of the northern half of the project area, while the southern half of the area is more severely eroded. This dichotomy also affects the vegetative communities.

VEGETATION

Vegetation in the quatrilateral Mill Race project area may be divided into two distinct shrub-grassland communities. Roughly the southern ½ of the area is heavily cut by intermittent seasonal drainages. As a result, developed soils are sparse. This area supports creosote (Larrea tridentata), tarbush (Flourensia cernua) and saltbush (Atriplex canecens) in almost all areas. Grasses such as grama (Bouteloua sp.) and dropseed (Sporobolus sp.), as well as broom snakeweed (Gutierrezia sarothrae) and soaptree yucca (Yucca sp.) are less common but occur where some soil development has occurred.

The northern half of the project area is not subject to the heavy alluvial erosion which characterizes the southern half. This area is dominated by a yucca/mesquite grassland established on developed sandy soils. Mesquite (Prosopis juliflora), soaptree yucca (Yucca sp.), winterfat (Eurotia lanata), dropseed (Sporobolus sp.), grama (Bouteloua sp.), as well as a variety of other grasses and annuals are the common forms of vegetation. Low areas have the highest vegetative density while the rolling ridge tops are only slightly less productive. Creosote and tarbush are rare in the northern area.

Only one archaeological site (WS 213) was found in the northern zone. The other four sites were all found in the eroded, exposed southern area.

SURVEY METHODS

The survey was directed by Karl W. Laumbach, assisted by Kira Silverbird, Glenda Hilley and Bill Bloch. Although the boundaries of the project area were supposed to have been flagged prior to the survey, the actual flagging of the perimeters was not completed until several days had elapsed. Luckily the roads which cut through the area served as approximate reference boundaries for the initial portion of the field survey. Even so, once the flags were in, it was discovered that areas outside of the project area had been inadvertently surveyed due to the lack of flagging.

Maps to the area were supplied by Mr. Fred Perea of Facility Engineering. All of the area was surveyed on foot. The survey was accomplished by lining the crew members up at 25-30 meter intervals from a convenient starting point and then walking until the opposite end of the survey area was reached. Shrubs were flagged by crew members on opposite ends of the line to insure that the return transect would cover the ground adjacent to the first transect.

When cultural resources were located, the crew leader was notified. Isolated artifacts were collected and plotted on a map of the project area. If a site was found, the area was flagged so that it could be easily relocated. When the survey of a project area was completed, each site was revisited and recorded. Recording including determination of site boundaries, a description of the site's environment, artifacts and features, and the drafting of a map depicting the site and associated features. Those artifacts, as well as the isolated occurrences, were collected and deposited at the New Mexico State University Museum.

POTENTIAL IMPACTS ON CULTURAL RESOURCES BY CONSTRUCTION

Direct Impact

Direct impact is the immediate effect on an area from construction and development. In archaeological terms, this may mean the destruction of archeological or historic sites by earthmoving, plowing, or flooding. Such minor construction-related activities as leveling ground for equipment parks has, in a few instances, destroyed sites outside the formal right-of-way. On other occasions, construction workers have intentionally destroyed archaeological or historical sites for the purpose of obtaining artifacts. Any activity outside of the surveyed areas should be checked for archaeological remains, since even minor disturbances can lead to the destruction of significant archaeological data.

Direct impacts on cultural resources were reduced by the collection of all artifacts and the testing of hearths.

Indirect Impact

Indirect impact is the adverse, long-term effect on non-renewable cultural resources which results from construction activity. Roads for the project can lead to easier access, thus increasing travel and the amout of vandalism. Also, earth disturbances may increase the amount of wind and water erosion.

Potential indirect impacts on cultural resources should not be present unless construction activities occur outside of the project area.

SURVEY RESULTS

Five archaeological sites and twenty-four isolated occurrences were found during the survey. All of the sites were small (less than 70 artifacts) and heavily eroded. Three of the sites contained one eroded hearth indicated by fire-cracked rock.

COLLECTION AND TESTING PROCEDURES

Due to their small size, the sites were mapped and surface collected during the survey. The three hearths were tested by excavation. None of the hearths contained charred materials. Due to erosion, the artifacts were exposed on sterile non-cultural soils. Data recovered by testing and collection are discussed in this report.

RECOMMENDATIONS

Additional data can not be recovered by further fieldwork. Archaeological clearance is recommended.

THE COLLECTION OF FIVE SMALL SITES NEAR MOCKINGBIRD GAP

Research Perspective

The sites found during the survey were uniformly small and lacked many temporally or culturally diagnostic artifacts. As three of the sites, WS 209, WS 210, and WS 212, contained no sherds and did contain evidence of biface manufacture, it is possible that they are of the Archaic period. The other two sites, WS 211 and WS 213, contained brownware sherds. These sherds were produced throughout the local Formative sequence, but because painted varieties were not present an early Formative date is suggested. This suggestion is bolstered by the presence of late Archaic style points in association with the sherds from WS 213.

Four of the sites were located in close proximity to each other in a well-drained creosote grassland. The fifth site, WS 213, was removed from this zone by only a short distance. Presumably, the sites were located close to desired vegetal resources so that they could be processed while hunters took advantage of game on the nearby grassy plains.

Late Archaic and early Formative sites containing low artifact densities are known to occur in a wide variety of resource areas in the Tularosa Basin (Wimberly et al. 1977). The goals of the artifact collection from the Mill Race sites were to obtain additional temporal data in the form of diagnostic artifacts and to obtain technofunctional data in order to define the observable range of activities within the shrub-grassland resource area. The determination of exactly what resources were being exploited must wait for sites with better preservation.

The Method

The surface of all of the sites had been severely eroded by water. As a result, features and artifact concentrations were easily recognized. The sites were mapped by flagging the perimeters of artifact scatters and measuring distances between flagged points. Within this framework hearths, artifacts, or artifact concentrations were located. As the artifacts were extremely dispersed, sample areas were used to stratify collections within the site. The goal of collection in each area was to obtain all artifacts present. All artifacts observed were collected. Shaped and utilized artifacts as well as those in close association to a hearth were individually mapped. All artifacts were individually bagged and numbered. The collected materials were analyzed at New Mexico State University.

The location of each observed hearth was mapped regardless of its state of erosion. Each hearth was tested by excavation to ascertain the presence of charred organic material.

Analysis of Stone Artifacts

Analysis of recovered artifacts was done at New Mexico State University by Karl W. Laumbach and Toni Sudar-Laumbach. Each of the tools is described and the information summarized on a reference chart. The pieces of lithic manufacturing debris were recorded on a form from which data could be easily quantified. A summary table of both tools and debitage is presented with site discussions.

Terms used in the analysis and discussion of the lithic (stone) tools are based on artifact definitions used during the analysis of artifacts from near Farmington, New Mexico (Laumbach 1980b) and from previous analyses of Archaic lithic material from the Tularosa Basin (Laumbach 1980a, 1981).

Bifaces

Bifaces are defined as flakes or specialized cores modified by flakes scars which extend from the edges to over one-third or more on both faces. The entire perimeter of the artifact is usually so modified. Bifaces are not to be confused with flakes which have only marginal modification or retouch on two faces of the same edge. Projectile points, knives, and other tools which are specialized bifaces are included in this general classification.

A number of bifaces fit into established projectile point typologies (Irwin-Williams 1973, 1980; Suhm and Jelks 1962; Sayles & Antevs 1941; Dick 1965). These are described according to the system used by Dr. Emil Haury for Ventana Cave (1950:243-303). Other bifaces, not as easily typed, may have been discarded preforms, knives, cores, scrapers, or a host of other functional items. Until such tools are found in an archaeological context which conclusively demonstrates their function or functions, they must be categorized simply as bifaces.

Retouched Flakes

Retouched flakes were described by these attributes: 1) shape, 2) complete or fragmentary, 3) type of modification (e.g., unifacial, bifacial, one or more edges), and 4) presence of wear patterns. The majority of modified flakes were shaped by percussion. Such tools may have had a variety of functions. It can be postulated that steep edge angles created by unifacial flake removal probably represent scraping planes. However, the removal of those flakes may have been necessary to resharpen a working edge dulled during a skinning or cutting function. Flakes with steep dorsal retouch on the lateral and proximal edges are called end scrapers and are generally recognized as a distinct artifact class.

Cores

Cores are pieces of lithic material which have had flakes removed to use the detached flake as a tool or to shape the core into a tool. Many of the cores found are thought to have been reduced to the point that suitable flakes could no longer be produced.

Attributes monitored during the analysis of cores included the presence or absence of cortex and the presence of single or multiple platforms. Single platform cores are those from which all flakes are struck in a common direction from a common platform.

Multiple platform cores fell into two categories, bidirectional cores which are the result of striking a series of flakes across the old platform surface of a single platform core, and cores from which flakes were removed in an unsystematic, opportunistic manner.

Hammerstones

Hammerstones are defined as those stones which are thought to have been utilized as hammers in the reduction of lithic material. They are recognized by battering wear on one or more surfaces. Occasionally, negative flake scars may occur as a result of use.

Ground Stone

Attributes monitored during analysis of the ground stone included: 1) fragmentary or complete, 2) shaped or unshaped, and 3) direction and location of striae and battering wear when discernible. Additional comments were added as necessary (e.g., appeared fire-cracked).

Manos and Metates

The ground stone may be divided into two general categories, the mano which is held in the hand and a larger stone called the metate. The smaller stone is used to grind material placed on the larger.

Of the three general varieties of metate, only the slab form was found in the study area. The trough metate is more commonly found on later Puebloan habitation sites. Slab and basin metates, in contrast, are common on seasonal procurement sites from all periods. Originally associated with Archaic traditions, they continued in use on seasonal sites throughout the Formative period. Several one-hand manos were recovered. Although sometimes shaped by pecking, the stones utilized as manos were often unmodified prior to use. Utilization of such stones often determines their shape. Two-hand manos, commonly associated with trough metates (Chapman 1977:451), were not in the assemblage.

Attributes Monitored on Debitage

Material type was monitored to determine whether or not a specific or general source area for lithic materials could be identified and to determine if a particular material was preferred over others for use in a specific task. Dr. Russel Clemons of the Department of Earth Sciences, New Mexico State University, identified materials.

Debitage type includes three subcategories: whole flake, partial flake, and non-diagnostic shatter. A whole flake is defined as a piece of debitage which possesses a platform and a hinge, step, or feather termination. A partial flake may be missing one or both of these attributes. Non-diagnostic shatter (Bucy 1974) is that angular debris which is detached during flake removal that does not necessarily possess attributes of a flake. This was frequently difficult to distinguish from partial flakes. These designations were monitored to aid in the quantification of material types and the determination of material workability. Material with a number of natural or weathered fractures will produce more angular debris and be more difficult to work than more homogeneous materials.

Cortex is the outer surface which develops on lithic material as a result of weathering through geologic time. Cortex formed by stream tumbling is generally smooth and often has overlapping conchoidal fractures. Cortex formed by other means (e.g., wind erosion) tends to be rough and more angular. Its presence was monitored as a measure of proximity of the quarry area. If little cortex was present in an assemblage one might assume that the Native American was some distance from the material source and had removed the unusable cortex and extra weight to make his trip home easier. The reverse inference could be made if considerable cortex were found in the assemblage. Thus, the amount of cortex present in an assemblage may reflect the distance to lithic source areas.

Converging flake scars and platform preparation were monitored in an effort to determine the relative degree of association between these variables and biface manufacture. Biface manufacture is thought to have been much more frequent during the Archaic period. An evaluation of the CGP survey data (Chapman 1977:949-519) shows that 66 of the 93 Archaic sites recorded (71%) contained bifaces, a class of artifacts which include projectile points. In contrast, only 17 of the 181 Anasazi sites (9.3%) contained bifaces. Overall, Archaic bifaces outnumbered Anasazi bifaces 297 to 29 or approximately 10 to 1. Therefore, it seems logical that sites which do not contain ceramics but which do contain bifaces, or evidence of biface manufacture, could be assigned to the Archaic stage with some degree of certainty.

Converging flake scars are found on the dorsal surface of some but not all flakes associated with biface manufacture. They are recognized as flake scars which were initiated at an edge opposite the platform of the flake. Converging dorsal scars are formed in the advanced stages of biface manufacture, but only when one edge of a biface has had flakes removed and the opposing edge of same surface is being worked. Flakes possessing such dorsal flake scars may also be produced during the process of resharpening bifaces. This attribute was monitored on all flakes and flake fragments upon which impact direction could be recognized.

Analysis of debitage from Block II of the Navajo Indian Irrigation Project near Farmington, New Mexico (Laumbach 1980b) determined that flakes derived from biface reduction could be identified by the presence of platform preparation and bidirectional or converging flake scars. Furthermore, because lithics from all temporal periods were analyzed during the Block II project, it was demonstrated that percussion biface manufacture as well as flakes with these biface attributes were largely restricted to the Archaic period. The WSMR assemblages provide an excellent setting to test this hypothesis in a different area.

Recent analysis of lithic assemblages from eleven Archaic sites in the Tularosa Basin have verified their role as a core/core tool in Archaic lithic assemblages. Furthermore, they are recognized as one aspect of a pattern of efficient curation behavior regarding lithic tools which characterizes the lithic technologies of Archaic groups in the Basin and probably elsewhere in the Southwest (Laumbach 1980a, 1981).

Platform preparation was defined by two or more flake scars present on the platform of a flake. Scars should emanate from the dorsal surface of the platform. This preparation is usually visible when viewing the long axis of the ventral surface of a flake because the surface of such a platform tends to be at an acute angle to the dorsal surface. It is necessary to remove these small flakes when manufacturing a biface to obtain the proper platform angle to which to control the detachment of the desired flake. This control over flake removal allows the knapper to systematically shape the biface. Unfortunately, because preparation isolates a particular area to strike, prepared platforms are often crushed on impact.

Other methods of platform preparation include beveling and abrading the edge to strengthen the platform in order to remove a large flake (Crabtree 1972:84). Abrasion removes small projections which would lessen the shock of a blow. These methods were not monitored, as the aeolian sand in the project area has made platforms prepared in these fashions virtually indistinguishable from unprepared platforms which have undergone considerable weathering. The presence of platform preparation was monitored only when flake scar facets appeared on the platform as described.

CERAMIC ANALYSIS

Toni Sudar-Laumbach

An analysis was performed on 43 brownware sherds collected from surface contexts at WS 211 and WS 213 and one isolated occurrence. The analysis was designed to monitor significant technological data for the purpose of classification. Attributes monitored to obtain technological data included method of construction, surface color and finish and temper type. These criteria were selected to provide information for the identification of cultural and temoporal affiliation of the sherds by comparision to known types.

Vessel forms were monitored and quantified when possible to allow inferences relating to site functions. Criteria used for determining vessel form were the relative amount of polish on interior and exterior surfaces and the presence or absence of scraping marks and pitting on one surface. Interior and exterior surfaces of vessels were recognized by the curvature of the sherd. A combination of exterior polishing and interior scraping indicated a "closed" or jar form. Polish on the interior surface and exterior scraping or polish on both surfaces indicated "open" or bowl forms.

The sherd assemblage was weathered and eroded as a result of aeolian action on the low fired, intermittently polished surfaces. The inability to adequately monitor polish made it difficult to determine vessel forms. Although this factor presents a degree of possible error, the analysis determined that 42 sherds were jar forms and one sherd was undifferentiated. The overwhelming number of jar sherds may be significant in respect to site function. High frequencies of jar sherds suggests vessels for storage and transport. Jar sherds in association with projectiles, flake tools and grinding implements on a nonstructural site would indicate that the prehistoric aborigines were using the area to locate procurement base camps for exploiting the surrounding environment.

No rim sherds were collected from the project area. The lack of rim sherds within the assemblage eliminated the possibility of comparisons with the tentative seriation developed for El Paso Brown ware from the Hueco Bolson located east and the north of El Paso, Texas (Whalen 1978:58-70). Although it has not been established that the brownware from the project area is El Paso Brown, comparisons with Whalen's developmental sequence for the Hueco Bolson may have provided a tentative chronological placement for the assemblage.

The color of each brownware sherd was determined with a Munsell Soil Color Chart (1975 edition). This provided a standard classification for the surface colors observed. Color names and Munsell values for the assemblage are listed in Table 1. The purpose of monitoring surface color was to apply a standarized method of comparison. A majority (23.3%) of the sherds were classified as "reddish brown", 16.3% were "dark brown" and 11.6% were "brown". The remaining were ordered by color values between these hues. The surface color of pottery (plain or slipped) is dependent upon the amount of iron and other elements present in the clay. This factor along with type and duration of the firing atmosphere will give clay a variety of colors. Selection of raw materials for pottery production is conditioned by the environment and not necessarily by cultural tradition. Surface color may not reflect culturally determined patterns of clay selection and in the case of this analysis did not prove to be a useful criterion for typological classification.

One temper group was identified in the ceramic assemblage. Identification of the mineral constituents were based on observations made with a 20x binocular microscope. The temper particles are predominately angular and occur primarily as fragments less than one millimeter in diameter. Particles are evenly distributed in large quantities throughout the paste. They are characterized by opaque grey and white particles in combination with translucent quartz. Auxilliary minerals include dense black particles and occasionally biotite. It is thought that this tempering material is an igneous rock type, possibly granite, felsite or diorite. The angular temper particles may indicate that the

Table 1. Munsell color notations and color names for the ceramic assemblage.

SITE	Reddish Brown 5YR 4/3	Reddish Brown 5YR 5/3	Reddish Brown 5YR 5/4	Light Reddish Brown 5YR 6/4	Dark Brown 7.5YR 4/2	Brown 7.5YR 5/2	Brown 7.5YR 5/4	Light Brown 7.5YR 6/4
3		3	10	4	1		4	1
5	8	1			6	4		
Isolated Occurrence							1	
TOTALS	8 (18.6%)	4 (9.3%)	10 (23.3%)	4 (9.3%)	7 (16.3%)	4 (9.3%)	5 (11.6%)	1 (2.3%)

resource material was ground on a metate. More likely the temper was detrital material (weathered, disintegrated rock) and was utilized without preparation.

The rock type identified by the analysis may or may not be indigenous to the project area. It is also likely that this temper/rock type represents one of several possible regional varieties of rock utilized for Jornada/El Paso brownware production. It is emphasized that pottery making groups of any region may have utilized more than one type of tempering material. In the case of this analysis, with a small sample of sherds, the temper type identified falls within the variation known for brownwares produced throughout the Tularosa Basin. This factor makes it difficult to rely upon temper type as a useful criterion for classification.

Conclusion

The data suggests that the brownwares recovered from the Mill Race project area are morphologically similar to Jornada Brown (Mera 1943: 12; Jelinek 1967: 47-49) and El Paso Brown (Lehmer 1948:94). Both types share similar developments and were produced circa A.D. 400 to A.D. 1350 (Whalen 1977; 1978). Spatial distribution for the pottery types is that shown for the Jornada Branch of the Mogollon (Lehmer 1948:10, Figure 1). Both have been reported in occur as far east as the Middle Pecos drainage (Jelinek 1967:47) and the New Mexico-Texas border (HSR 1973:378-332; Jennings 1940:5-6).

The published descriptions of El Paso Brown and Jornada Brown do not indicate appreciable technological differences between the two types. Therefore, for the purposes of this analysis the type names of El Paso Brown and Jornada Brown will be hyphenated and considered to represent a distinct brownware. The term Jornada-El Paso brownware includes implications of similarity in technological features, a common geographical location, and cultural relationships.

SITE FORMS, ARTIFACT INVENTORIES AND DISCUSSION

F1750 R10/78)

NEW MEXICO STATE UNIVERSITY ARCHAEOLOGICAL SURVEY Mill Race Project SITE NO. LA ______

Site name WS 209 Quad no. ______ Field No. 1

Map source USGS Mockingbird Gap 15' Accessibility foot X sedan X 4-wh. dr ______ backhoe ______

SW ¼ of the NW ¼ of the SW ¼, Sec. 13, T. 8 N/(S), R. 4 (E)/W., County Socorro State NM

Location 100 meters west of Range Road 13

Elevation 4850'

Stake location (MNM, Other:) ______

Site is in what nearest named drainage? Rio Grande Nearest town Bingham Nearest highway NM 380

Ownership White Sands Missile Range Informant ______

FEATURES (indicate number): Pit houses ______ Kivas ______ Surface rooms: Slab/Jacal ______ Masonry ______ Adobe ______ Other ______

Refuse area (direction) ______ Hearths ______ Burials ______ Sherd/(Chipping) area X Grids/Dams/Terraces/Borders ______ Petroglyphs/Pictographs ______

Trails/Steps/Toeholds ______ Other No features were observed

PLAN (check ✓): 1-room ______ Arc ______ Linear ______ L-shaped ______ C-shaped ______ F-shaped ______ E-shaped ______ ( )-shaped ______

Enclosed plaza: by a wall ______ by rooms ______ Scattered dwelling units ______ Indeterminate ______ Other ______

Single-tier ______ Double-tier ______ ( )-tiers ______ Part double-tier ______ Part ( )-tiers ______ Orientation E-W Exposure Open

Modern structures on site No

Nature and depth of fill lag gravels and silt sand Area of site 45 x 45 (meters)/feet

Condition: Undisturbed ______ Eroded X Pot-hunted ______ Pottery/Artifact abundance: 0, (10's), 100's, 1000's Multiple component site? ______

SITUATION (check ✓): Valley bottom ______ Bench/Terrace ______ Slope ______ Ridge X Mesa top ______ Cliff edge ______ Overhang ______ Cave ______

Dune ______ Other low rolling ridge top

Terrain: Level ______ Broken X Slopes to (direction) SW Surface deposits: Alluvium X Colluvium ______ Aeolian X Talus ______ Residual ______

Soil: Rocky ______ Gravelly X Sandy X Clayey ______ Other ______ Local outcrops: Sandstone ______ Shale ______ Limestone X

Basalt: ______ Tuff ______ Caliche X Other Chert lag gravels Arable land (type, distance & direction) ______

Water (distance & direction): River ______ Arroyo ______ Stream confluence ______

Spring/Seep Hoffman Spg. 6 miles SE Bedrock pool ______ Local vegetation patterns Creosote, tarbush, dropseed, snakeweed, mormon tea, narrowleaf yucca, saltbush

Field remarks Light lithic scatter (14 pieces) on low rolling ridge. Artifacts widely scattered. Thin layer of sand covers caliche, many lag gravel deposits. Two artifacts are crude bifaces, another is unifacially retouched. All are chert.

Impact: Type Blading with heavy equipment Direct X Induced ______

Mitigation? Avoid ______ Monitor ______ Test X Excavate ______ Not Required ______

Statement of Eligibility ______ Nat'l Register Nomination ______ Date ______

CULTURE unknown (component 1) / ______ (component 2) Phase or Date unknown (Archaic?) (component 1) ______ (component 2)

Zone ______ Locality ______ Photo: B/W ______ Color ______

Lab remarks Bifaces suggest Archaic affiliation. Site was collected

UTM REFERENCE

13 / 362150 / 3719925
zone / easting / northing

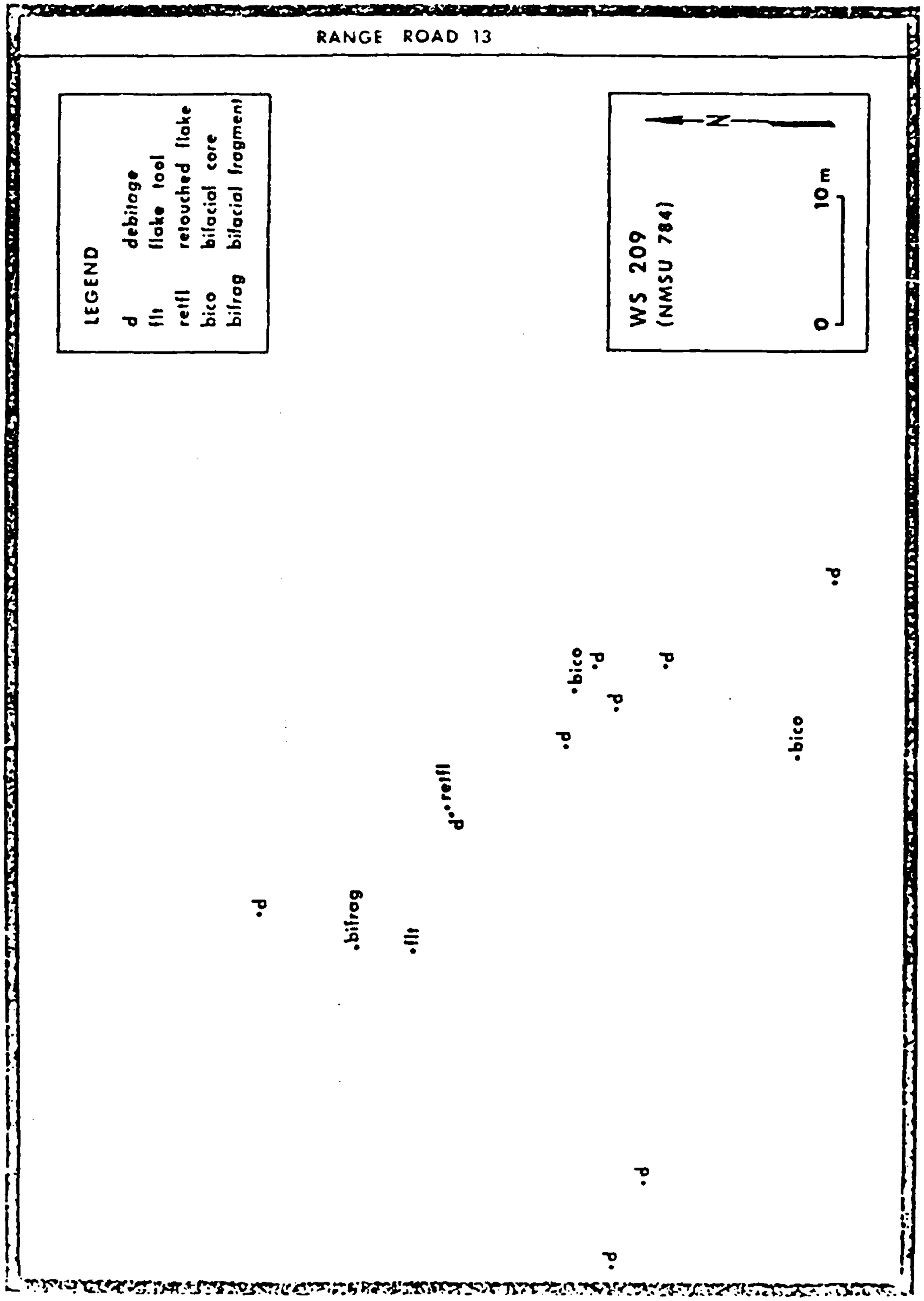
NMSU Site No. 784

NMSU Report No. 439

Field recorder K.W. Laumbach Date Dec. 11, 1980

Lab recorder K.W. Laumbach Date Jan. 30, 1981

10-78PDC:M


RANGE ROAD 13
LEGEND
d debitage
flt flake tool
retfl retouched flake
bico bifacial core
bifrag bifacial fragment
WS 209
(NMSU 784)
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WS 209: DISCUSSION

Fourteen lithic artifacts were recovered from WS 209. None are clearly diagnostic of either a temporal period or a cultural sequence. The presence of three crude bifaces and three flakes exhibiting converging flake scars suggests that the occupation may have been Archaic.

The bifaces, the steeply retouched flake (scraper), and the lack of ground stone suggest that the site may have functioned as a butchering area or at least served some function related to hunting activities. The location of the site allows a wide area to the west and southwest to be observed. The chert from which all the artifacts are manufactured is available locally in the log gravels of the Oscuras.

SITE NUMBER WS 209
ARTIFACT SUMMARY

MATERIAL	Reduced Cores (both bifacial)	Biface fragment
CHERT	2	1
100%	67%	33%

SITE NUMBER WS 209

DEBITAGE SUMMARY

MATERIAL		Whole flakes	Partial flakes	Cortex on dorsal	Single facet	Multi- facet	Absent	Converging scars	Microflake removal	Retouch
CHERT	11 100%	4	7	3	3	1	7	3	1	1
		36%	64%	27%	27%	9%	64%	27%	9%	9%

NEW MEXICO STATE UNIVERSITY ARCHAEOLOGICAL SURVEY Mill Race Project SITE NO.: LA

Site name WS 210 Quad no. : Field No. 2

Map source USGS Mockingbird Gap 15' Accessibility: foot X sedan X 4-wh. dr. X backhoe X

SE ¼ of the SE ¼ of the SE ¼, Sec. 14, T. 8 N/S, R. 4 E/W., County Socorro State NM

Location 400 meter west of Range Road 13, southeast of dirt tank

Elevation 4850'

Stake location (MNM, Other)

Site is in what nearest named drainage? Rio Grande Nearest town Bingham Nearest highway NM 380

Ownership White Sands Missile Range Informant

FEATURES *(indicate number)*: Pit houses Kivas Surface rooms: Slab/Jacal Masonry Adobe Other

Refuse area *(direction)* Hearths 1 Burials Sherd/Campsite area Grids/Dams/Terraces/Borders Petroglyphs/Pictographs

Trails/Steps/Toeholds Other Light scatter of lithic material along eroded slope

PLAN *(check ✓)*: 1-room Arc Linear L-shaped C-shaped F-shaped E-shaped ( )-shaped

Enclosed plaza: by a wall by rooms Scattered dwelling units Indeterminate Other

Single-tier Double-tier ( )-tiers Part double-tier Part ( )-tiers Orientation NE-SW Exposure Open

Modern structures on site No

Nature and depth of fill alluvial gravels Area of site 90 x 50 meters/feet

Condition: Undisturbed Eroded X Pot-hunted Pottery/Artifact abundance: 0, 10's, 100's, 1000's Multiple component site? No

SITUATION *(check ✓)*: Valley bottom Bench/Terrace Slope X Ridge Mesa top Cliff edge Overhang Cave

Dune Other

Terrain: Level Broken X Slopes to *(direction)* SW Surface deposits: Alluvium X Colluvium Aeolian Talus Residual

Soil: Rocky Gravelly X Sandy X Clayey Other Local outcrops: Sandstone Shale Limestone

Basalt Tuff Caliche Other Arable land *(type, distance & direction)*

Water *(distance & direction)*: River Arroyo Stream confluence

Spring/Seep Hoffman Sprg 6 miles SE Rincon pool Local vegetation patterns Creosote, tarbush, saltbush, dropseed, mormon tea

Field remarks 36 pieces of lithic material on eroded gravel slope. Hearth is eroded, marked by firecracked rock. No temporally or culturally diagnostic artifacts. No groundstone.

Impact: Type blading with heavy equipment Direct X Indirect

Mitigation? Avoid Monitor Test X Excavate Not Required

Statement of Eligibility Nat'l Register Nomination Date

CULTURE unknown (component 1) / (component 2) Phase or Date Archaic ? (component 1) / (component 2)

Zone Locality Photo: B/W Color

Lab remarks 33% of debitage exhibit converging dorsal scars. This attribute suggests biface manufacture which in turn suggest an Archaic affiliation. Site was collected

UTM REFERENCE

/ 13 / 362400 / 3719250
zone easting northing

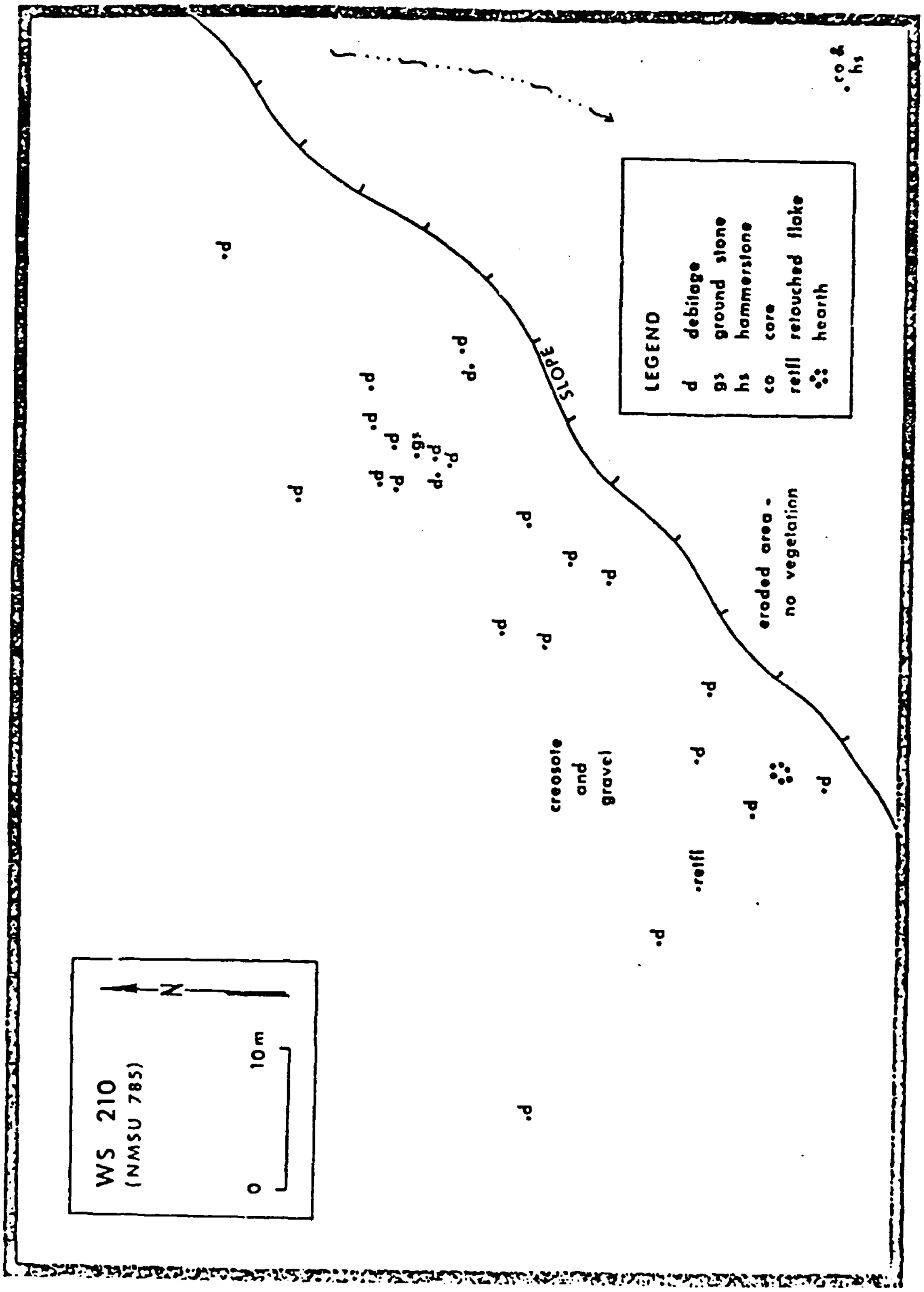
NMSU Site No. 785

NMSU Report No. 439

Field recorder K.W. Laumbach Date Dec. 11, 1980

Lab recorder K.W. Laumbach Date Feb. 20, 1981

10/78PDC:M


WS 210
(NMSU 785)
N
0
10m
SLOPE
creosote
and
gravel
eroded area -
no vegetation
LEGEND
d debitage
gs ground stone
hs hammerstone
co core
retfl retouched flake
hearth
co &
hs
retfl

WS 210: DISCUSSION

Thirty-six stone artifacts were collected from WS 210. Of these, two were cores, two were hammerstones and two were mano fragments. The remainder were lithic debitage. None of the artifacts can be considered clearly diagnostic of a particular temporal period or cultural sequence. The fact that 33% of the debitage exhibit converging dorsal scars suggest biface manufacture and a possible Archaic component. However, no bifaces were found.

The site appears to have been the scene of core reduction, biface manufacture, the processing of vegetal resources and at least one fire. The range of activities suggests that it functioned as a temporary base-camp for resource procurement in the nearby area.

The use of limestone as a lithic source is indicative of opportunistic use of local lag gravels.

SITE NUMBER WS 210
ARTIFACT SUMMARY

MATERIAL			Cores	Hammer/battering stones	manos/grind stone Fragment
SANDSTONE	1	33%		1	
LIMESTONE	2	66%	1	1	1
TOTAL	3	100%	1	1	1
			33%	33%	33%

SITE NUMBER WS 210

DEBITAGE SUMMARY

MATERIAL			Whole flakes	Partial flakes	Shatter	Cortex on platform	Cortex on dorsal	Unprepared platform	Single facet	Multi- facet	Absent	Converging scars	Retouch
CHERT	14	42%	6	7	1		2		10		3	7	1
LIMESTONE	15	45%	14	1		1	10	1	12	2		4	
QUARTZITE	4	12%	2	2			1		1	1	2		
TOTAL	33	100%	22 67%	10 30%	1 3%	1 3%	13 39%	1 3%	23 70%	3 9%	5 15%	11 33%	1 3%

F1750(R10/79)

NEW MEXICO STATE UNIVERSITY ARCHAEOLOGICAL SURVEY Mill Race Project SITE NO.: LA

Site name WS 211 Quad no. : Field No. 3

Map source USGS Mockingbird Gap 15' Accessibility: 4-wh. dr. X foot X sedan X backhoe

SE ¼ of the NE ¼ of the NE ¼, Sec. 23, T. 8 S N, R. 4 W. E, County Socorro State NM

Location Immediately northwest of intersection Range Road 7 and Range Road 13

Elevation 4850'

Stake location (MNM, Other)

Site is in what nearest named drainage? Rio Grande Nearest town Bingham Nearest highway NM 380

Ownership White Sands Missile Range Informant

FEATURES (indicate number): Pit houses Kivas Surface rooms: Slab/Jacal Masonry Adobe Other

Refuse area (direction) Hearths Burials Sherd/Chipping area X Grids/Dams/Terraces/Borders Petroglyphs/Pictographs

Trails/Steps/Toeholds Other

PLAN (check ✓): 1-room Arc Linear L-shaped C-shaped F-shaped E-shaped ( )-shaped

Enclosed plaza: by a wall by rooms Scattered dwelling units Indeterminate Other

Single-tier Double-tier ( )-tiers Part double-tier Part ( )-tiers Orientation E-W Exposure open

Modern structures on site Blading to construct erosion control ditches has disturbed most of the artifacts

Nature and depth of fill eroded to caliche except for vegetation and gravel Area of site 20 x 160 meters/feet

Condition: Undisturbed Eroded X Pot-hunted Pottery/Artifact abundance: 0, 10's, 100's, 1000's Multiple component site? ?

SITUATION (check ✓): Valley bottom Bench/Terrace Slope Ridge Mesa top Cliff edge Overhang Cave

Dune Other Drainage bottom, earlier situation hard to define because of disturbance

Terrain: Level Broken X Slopes to (direction) SW Surface deposits: Alluvium X Colluvium Aeolian Talus Residual

Soil: Rocky Gravelly X Sandy X Clayey Other Local outcrops: Sandstone Shale Limestone

Basalt Tuff Caliche Other Arable land (type, distance & direction)

Water (distance & direction): River Arroyo Stream confluence

Spring/Seep Hoffman Sprg. 6 miles SE Bedrock pool Local vegetation patterns Creosote, dropseed sideoats grama, tumbleweed, and snakeweed.

Field remarks Concentration of brownware sherds, one hand manos and debitage pushed together by blade. Extremely light scatter up the drainage to the east. No hearths or other features.

Impact: Type Blading with heavy equipment Direct X Induced

Mitigation? Avoid Monitor Test X Excavate Not Required

Statement of Eligibility Nat'l Register Nomination Date

CULTURE Jornada Mogollon (component 1) / (component 2) Phase or Date Mesilla Phase (component 1) / (component 2)

Zone Locality Photo: B/W Color

Lab remarks Site was collected

UTM REFERENCE

13 / 362425 / 3718900
zone easting northing

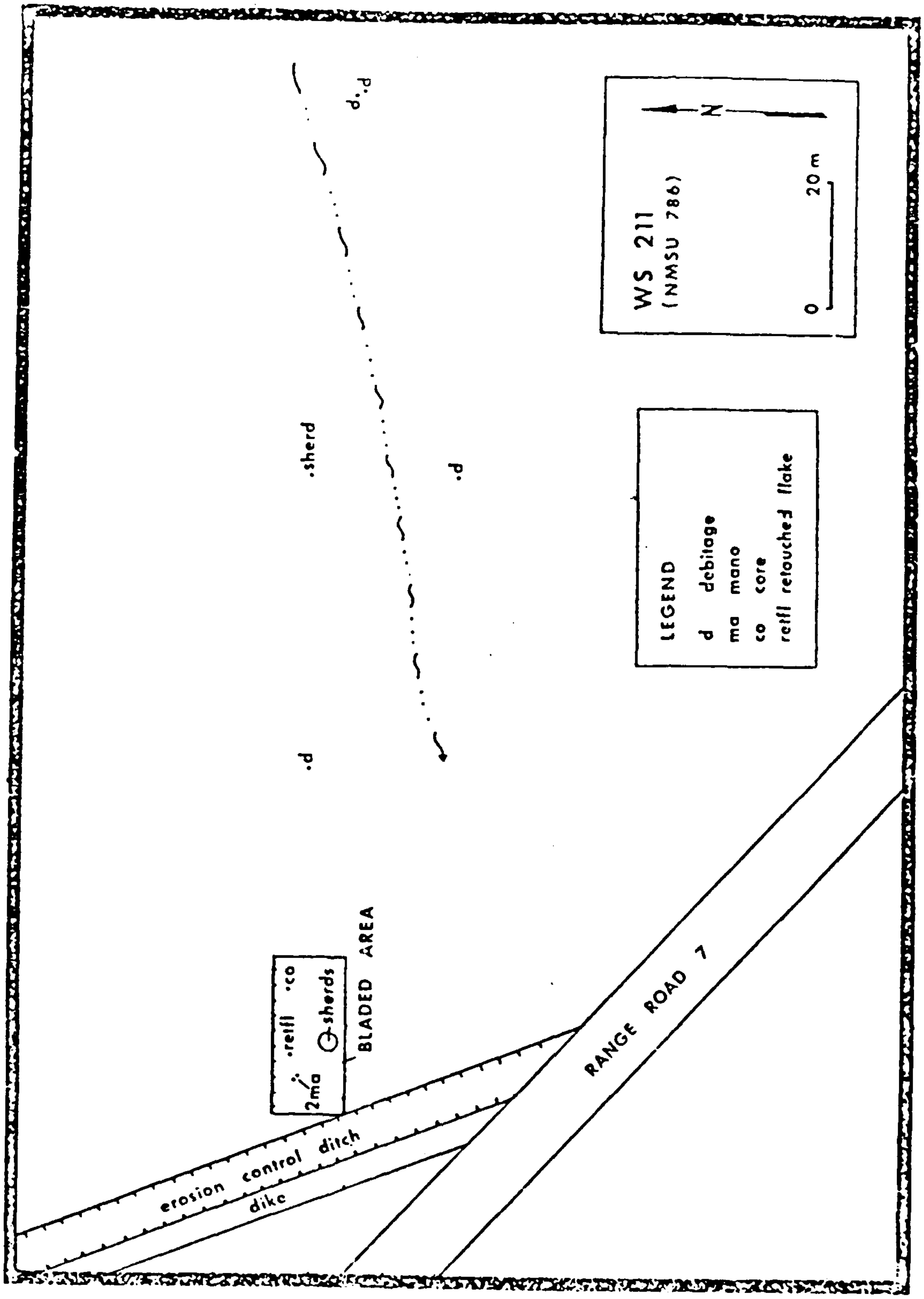
NMSU Site No. 786

NMSU Report No. 439

Field recorder K.W. Laumbach Date Dec. 11, 1980

Lab recorder K.W. Laumbach Date Feb. 15, 1981

10/73PDC1M


WS 211
(NMSU 786)
0
20 m
N
LEGEND
d debitage
ma mano
co core
retfl retouched flake
d.d
.sherd
d.
d.
retfl
co
2ma
sherds
BLADED AREA
erosion control ditch
dike
RANGE ROAD 7

WS 211: DISCUSSION

Sixty-six stone artifacts and 23 pottery sherds were recovered from WS 211. The stone artifacts include two one-hand manos, three cores, and three utilized or retouched flakes. The remainder are debitage. The pottery sherds are all brownwares. With the exception of the brownwares, none of the artifacts were temporally or culturally diagnostic. The brownwares were made over a 1000-year period and are only generally diagnostic of the Jornada Mogollon Formative sequence. The lack of painted types suggests but does not prove that the site was occupied during the early portion of the sequence. As no rim forms were recovered, the rim sequence developed by Whalen (1977, 1978) cannot be applied. The presence of biface thinning flakes strengthens a late Archaic/early Formative occupation date.

As the site had been badly impacted by both blading and erosion, the spatial arrangement of the artifacts is speculative. The range of activities suggested by the artifacts indicates a temporary base camp for procurement activities.

Although a slight majority of the artifacts were chert, the use of limestone as a lithic resource suggests opportunistic utilization of local gravels.

SITE NUMBER WS 211

ARTIFACT SUMMARY

MATERIAL			Cores	Reduced cores	manos/grind stone Complete
CHERT	1	20%		1	
LIMESTONE	2	40%	2		
SANDSTONE	1	20%			1
ANDESITE	1	20%			1
TOTAL	5		2 40%	1 20%	2 40%

SITE NUMBER WS 211

DEBITAGE SUMMARY

MATERIAL			Whole flakes	Partial flakes	Shatter	Cortex on platform	Cortex on dorsal	Unprepared platform	Single facet	multi- facet	Absent	Converging scars	Microflake removal	Retouch
CHERT	20	33%	8	8	4	1	6	1	9		6	5		2
LIMESTONE	18		18	12	2	6	9	6	18	1	5	8		
QUARTZITE	9	15%	4	4	1				4		4	3	1	
TOTAL	61	100%	30	24	7	7	15	7	31	1	15	16	1	2
			50%	39%	11%	11%	25%	11%	51%	2%	25%	26%	2%	3%

F1750(R10/73)

NEW MEXICO STATE UNIVERSITY ARCHAEOLOGICAL SURVEY Mill Race Project: SITE NO.: LA

Site name WS 212 Quad no. : Field No. 4

Map source USGS Mockingbird Gap 15' Accessibility: foot X sedan X 4-wh. dr. X backhoe X

SE ¼ of the NW ¼ of the SE ¼, Sec. 14, T. 8 S, R. 4 E, County Socorro State NM

Location 300 meter west of dirt tank which is northwest of Range Road 7 and Range Road 13 intersection Elevation 4820

Stake location (MNM, Other:)

Site is in what nearest named drainage? Rio Grande Nearest town Bingham Nearest highway NM 380

Ownership White Sands Missile Range Informant

FEATURES (indicate number): Pit houses Kivas Surface rooms: Slab/Jacal Masonry Adobe Other

Refuse area (direction) Hearths 1 Burials Sherd/Chipping area Grids/Dams/Terraces/Borders Petroglyphs/Pictographs

Trails/Steps/Toeholds Other Hearth indicated by firecracked rocks.

PLAN (check ✓): 1-room Arc Linear L-shaped C-shaped F-shaped E-shaped ( )-shaped

Enclosed plaza: by a wall by rooms Scattered dwelling units Indeterminate Other

Single-tier Double-tier ( )-tiers Part double-tier Part ( )-tiers Orientation N-S Exposure Southern

Modern structures on site No

Nature and depth of fill alluvial sand and gravels Area of site 150 x 120 meters/feet

Condition: Undisturbed Eroded X Pot-hunted Pottery/Artifact abundance: 0, 10's, 100's, 1000's Multiple component site? ?

SITUATION (check ✓): Valley bottom Bench/Terrace Slope X Ridge Mesa top Cliff edge Overhang Cave

Dune Other

Terrain: Level Broken X Slopes to (direction) SW Surface deposits: Alluvium X Colluvium Aeolian Talus Residual

Soil: Rocky Gravelly X Sandy Clayey Other: Local outcrops: Sandstone Shale Limestone

Basalt Tuff Caliche Other Arable land (type, distance & direction)

Water (distance & direction): River Arroyo Stream confluence

Spring/Seep Hoffman Sprg. 6 miles SE Bedrock pool Local vegetation patterns Creosote, tarbush, mormon tea, narrow leaf yucca, dropseed, and prickly pear.

Field remarks Extremely light scatter of lithic material over wide area of gradual slope. One basally notched projectile point, several pieces of ground stone. No sherds. Area is cut by many small arroyos.

Impact: Type Blading with heavy equipment Direct X Indirect

Mitigation? Avoid Monitor Test Excavate X Not Required

Statement of Eligibility Nat'l Register Nomination Date

CULTURE ? unknown (component 1) / (component 2) Phase or Date late Archaic ? (component 1) / (component 2)

Zone Locality Photo: B/W Color

Lab remarks The site was collected. The projectile point is similar to late Archaic Points in southwestern Texas (Shumla, 4000-1000 B.C)

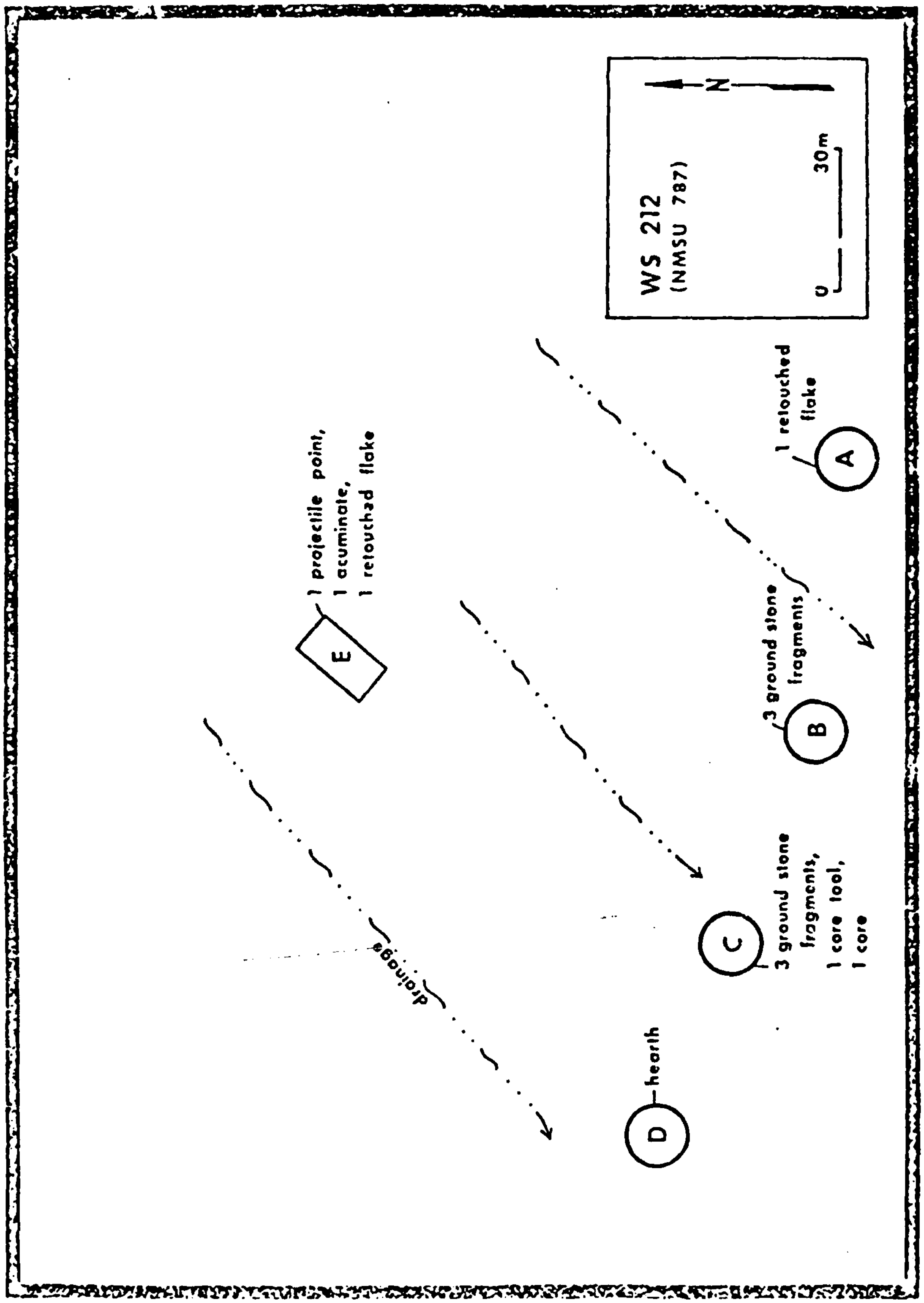
UTM REFERENCE
13 / 362800 / 3719750
zone / easting / northing

NMSU Site No. 787

NMSU Report No. 439

Field recorder K.W. Laumbach Date Dec. 11, 1980

Lab recorder K. W. Laumbach Date Feb. 18, 1981


WS 212
(NMSU 787)
N
0
30m
A
1 retouched flake
B
3 ground stone fragments
C
3 ground stone fragments, 1 core tool, 1 core
D
hearth
E
1 projectile point, 1 acuminate, 1 retouched flake
drainage

WS 212: DISCUSSION

Twenty-three stone artifacts were recovered from WS 212. These were found over a large eroded area. The artifacts include one projectile point, one acuminate, two cores, two retouched flakes, and six ground stone fragments. One of the cores displays a battered edge suggesting use in a chopping function. The projectile point is the only artifact which could be considered culturally or temporally diagnostic. It is made in the style of the "Shumla" point, a middle to late Archaic point from southwestern Texas (Suhm and Jelks). Some of these points

SITE NUMBER WS 212
ARTIFACT SUMMARY

MATERIAL			Cores	Core fragments	Projectile points	metate fragment
CHERT	2	22%		1	1	
LIMESTONE	1	11%	1			
SANDSTONE	6	66%				6
TOTAL	9		1	1	1	6
			11%	11%	11%	66%

have been found associated with western Archaic materials in the Tularosa Basin (Laumbach 1981).

The variety of artifacts suggests that this was a temporary camp from which to procure local plant and animal resources. One hearth was found which was completed eroded and indicated by fire-cracked rock. A high percentage of flakes exhibiting converging flake scars suggests that bifaces were either made or reworked at the site. All of the lithic materials could have been collected locally.

SITE NUMBER WS 212
DEBITAGE SUMMARY

MATERIAL			Whole flakes	Partial flakes	Cortex on platform	Cortex on dorsal	Unprepared platform	Single facet	multi- facet	Absent	Converging scars	Retouch
CHERT	10	71%	6	4		2		5	1	3	5	4
LIMESTONE	4	29%	4		1	2	1	3			2	
TOTAL	14		10 71%	4 29%	1 7%	4 29%	1 7%	8 57%	1 7%	3 21%	7 50%	4 29%

F1750(R10/78)

NEW MEXICO STATE UNIVERSITY ARCHAEOLOGICAL SURVEY Mill Race Project SITE NO.: L.A.

Site name WS 213 Quad no. : Field No. 5

Map source USGS Granjean Well 15' Accessibility: foot X 4-wh. dr. X sedan X backhoe X

NW ¼ of the SW ¼ of the SW ¼, Sec. 11, T. 8 N./(S.) R. 4 E./W., County Socorro State NM

Location 2 miles west of Road 7- Road 13 intersection and 800 meters north of Road 7.

Elevation 4770'

Stake location (MNM, Other)

Site is in what nearest named drainage? Rio Grande Nearest town Bingham Nearest highway NM 380

Ownership White Sands Missile Range Informant

FEATURES (indicate number): Pit houses ___ Kivas ___ Surface rooms: Slab/Jacal ___ Masonry ___ Adobe ___ Other ___

Refuse area (direction) ___ Hearths 1 Burials ___ (Sherd/Chipping area) ___ Cnds/Dams/Terraces/Borders ___ Petroglyphs/Pictographs ___

Trails/Steps/Toeholds ___ Other No features other than eroded hearth (firecracked rock).

PLAN (check ✓): 1-room ___ Arc ___ Linear ___ L-shaped ___ C-shaped ___ F-shaped ___ E-shaped ___ ( ) -shaped ___

Enclosed plaza: by a wall ___ by rooms ___ scattered dwelling units ___ Indeterminate ___ Other ___

Single-tier ___ Double-tier ___ ( ) - tiers ___ Part double - tier ___ Part ( ) - tiers ___ Orientation SE-NW Exposure Open

Modern structures on site No

Nature and depth of fill eroded to caliche Area of site 30 x 40 (meters)/feet

Condition: Undisturbed ___ Eroded X Pot-hunted ___ Pottery/Artifact abundance: 0, (10's), 100's, 1000's Multiple component site? ?

SITUATION (check ✓): Valley bottom ___ Bench/Terrace ___ Slope ___ Ridge X Mesa top ___ Cliff edge ___ Overhang ___ Cave ___

Dune ___ Other ___

Terrain: Level ___ Broken X Slopes to (direction) ___ Surface deposits: Alluvium X Colluvium ___ Aeolian ___ Talus ___ Residual ___

Soil: Rocky ___ Gravelly ___ Sandy X Clayey ___ Other ___ Local outcrops: Sandstone ___ Shale ___ Limestone ___

Basalt ___ Tuff ___ Caliche X Other ___ Arable land (type, distance & direction)

Water (distance & direction): River ___ Arroyo ___ Stream confluence ___

Spring/Seep Hoffman Sprg 6 miles SE Bedrock pool ___ Local vegetation patterns Soaptree yucca, mormon tea, black grama, dropseed, and other grasses stabilizing soils in small hummocks, In general, a yucca/grassland.

Field remarks Small scatter of brownsherds, projectile points, and debitage on low ridge overlooking grassy desert drainage. Area heavily eroded by water.

Impact: Type Blading with heavy equipment Direct X Indirect ___

Mitigation? Avoid ___ Monitor ___ Test X Excavate ___ Not Required ___

Statement of Eligibility ___ Nat'l Register Nomination ___ Date ___

CULTURE Jornada/Mogollon (component 1) / ___ (component 2) Phase or Date early Mesilla Phase (component 1) ___ (component 2)

Zone ___ Locality ___ Photo: B/W ___ Color ___

Lab remarks Brownware sherds in association with convex based corner notched "San Pedro" points and bifaces suggest late Archaic/early Formative affiliation. Site was totally collected

UTM REFERENCE

13 (zone) 361850 (easting) 3721150 (northing)

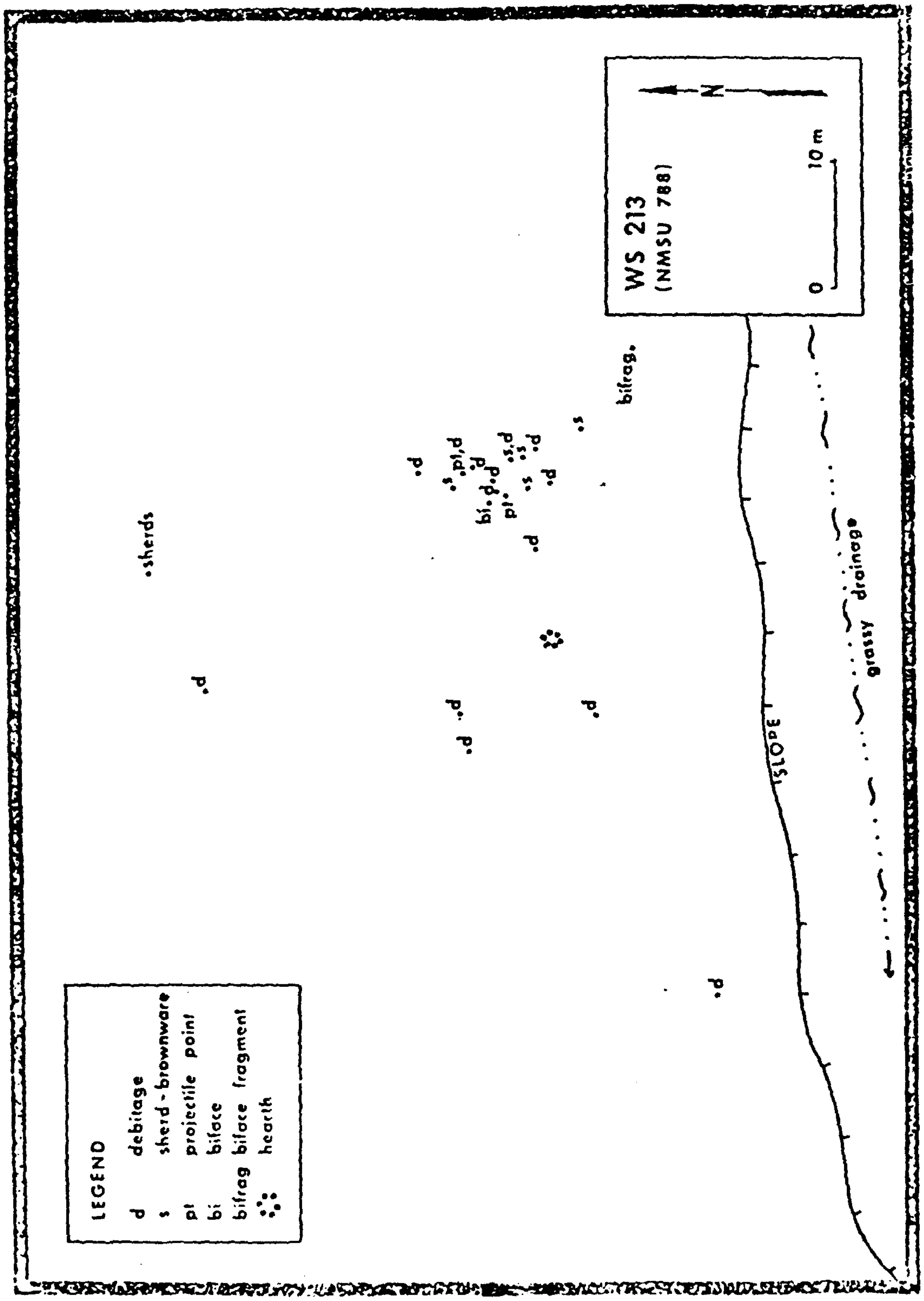
NMSU Site No. 788

NMSU Report No. 439

Field recorder K.W. Laumbach Date Dec. 11, 1980

Lab recorder K.W. Laumbach Date Feb. 20, 1981

10/78PDC:V


WS 213
(NMSU 788)
0
10 m
N
LEGEND
d debitage
s sherd - brownware
pt projectile point
bi biface
bifrag biface fragment
hearth
sherds
bifrag
SLOPE
grassy drainage

WS 213: DISCUSSION

Twenty-three stone artifacts and 19 pottery sherds were recovered from WS 213. One dispersed hearth was the only feature. Two of the projectile point are late Archaic is style and the lack of painted pottery suggests an early Formative date for the site. The brownware sherds are Jornada/El Paso Brown in style. No rim forms were present. Other artifacts include one retouched flake, a biface, and a biface fragment. No ground stone was found.

This site appears to be a temporary camp probably established to procure local plant and/or animal resources. Local lithic resources including limestone were utilized. A small percentage of flakes exhibiting converging flakes scars indicates that bifacialy tools may have been resharpened or maintained at the site.

SITE NUMBER WS 213
ARTIFACT SUMMARY

MATERIAL			Biface complete	Biface fragment	Projectile point
CHERT	4	100%	1	1	2
			25%	25%	50%

SITE NUMBER WS 213

DEBITAGE SUMMARY

MATERIAL			Whole flakes	Partial flakes	Shatter	Cortex on platform	Cortex on dorsal	Unprepared platform	Single facet	Absent	Converging scars	Retouch
CHERT	13	68%	5	5	3	1	2	1	4	5	2	1
LIMESTONE	5	26%	3	2			1		3	2	2	
QUARTZITE	1	5%	1						1		1	
TOTAL	19	100%	9	7	3	1	3	1	8	7	5	1
			47%	37%	16%	5%	16%	5%	42%	37%	26%	5%

ISOLATED OCCURRENCES DISCUSSION

Forty-five artifacts comprising 24 isolated occurrences of cultural material throughout the survey area were found. Of these 38 were lithic debitage, two were biface fragments, one was a projectile point, and three were ground stone fragments. The debitage was dominantly of chert from local sources. Three examples exhibited a retouched edge and another, microflake removal. A small percentage of the flakes suggested biface manufacture. The projectile point exhibited a contracting stem. This attribute places it tentatively into the middle or late Archaic periods. The ground stone included one mano fragment and two metate fragments. A small sandstone boulder exhibiting several small mortar-like holes on one surface was found in a playa bottom. The holes do not exceed 3 cm. in either depth or diameter. The function of this artifact is unknown.

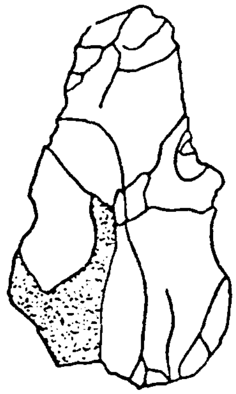
SITE NUMBER MILL RACE ISOLATED OCCURRENCES
ARTIFACT SUMMARY

MATERIAL			Biface fragment	Projectile points	manos/grind stone	metates	
					Fragment	Complete	Fragment
CHERT	3	50%	2	1			
GRANITE	1	17%				1	
SANDSTONE	2	33%			1		1
TOTAL	6	100%	2	1	1	1	1
			33%	17%	17%	17%	17%

MILL RACE ISOLATED OCCURRENCES

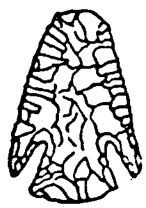
DEBITAGE SUMMARY

MATERIAL			Whole flakes	Partial flakes	Cortex on dorsal	Single facet	Multi- facet	Absent	Converging scars	Microflakes removal	Retouch
CHERT	37	97%	15	22	4	23	2	12	11	1	3
LIMESTONE	1	3%	1		1	1			1		
TOTAL	38	100%	16 42%	22 58%	5 13%	24 63%	2 5%	12 32%	12 32%	1 3%	3 8%



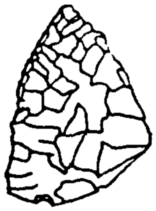
WS 209

WS 211

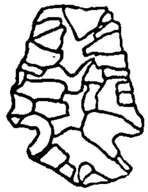


WS 212

Artifacts from MILL RACE Area



WS 213



WS 213

Isolated Occurrence

Artifacts from MILL RACE Area

CONCLUSION

In aggregate, the five Mill Race sites appear to represent small temporary campsites from which late Archaic and early Formative populations exploited the local resources. A tentative date for these sites would span the period between 1000 B.C. and A. D. 500. It is doubtful if any of the sites were occupied with any great regularity, based on the quantity of artifactual material.

The resources which they exploited were probably grass seeds and antelope based on today's environment. Residential sites used by this may have been located near watered locations in the San Andres or Oscuras Mountains. Alternately, they may have been based along the Rio Grande.

The collection of these sites has preserved data on the seasonal exploitation of the Mill Race area. It remains for future work to more properly integrate the data into the larger system which sustained these late Archaic, early Formative Stage populations.

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APPENDIX E-4

DEFENSE NUCLEAR AGENCY
WASHINGTON, D.C. 20305

OALG

2 FEB 1981

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING
ASSISTANT SECRETARY OF DEFENSE (MANPOWER, RESERVE AFFAIRS AND LOGISTICS)
COMMANDER, WHITE SANDS MISSILE RANGE, ATTN: STEWS-FE
COMMANDER, FIELD COMMAND, DEFENSE NUCLEAR AGENCY

SUBJECT: Environmental Assessment for the MILL RACE High-Explosive Test

1. Reference DOD Directive 6050.1, Environmental Effects in the United States of DOD Actions, 30 July 1979.

2. Attached is the Environmental Assessment for the MILL RACE High-Explosive Test which is to be conducted at the US Army White Sands Missile Range, New Mexico. The findings of the Environmental Assessment show that the program will not have a significant effect on the quality of human environment. No controversy concerning the program has been identified.

3. Based on a review of the above findings and the guidelines contained in the reference, I have determined that an Environmental Impact Statement is not necessary for this event. A Finding of No Significant Impact is attached.

4. Since the proposed action is primarily of local concern, request the Commander, Field Command, DNA, in coordination with the Commander, White Sands Missile Range, conduct an aggressive local public affairs program to insure public awareness of the project and to insure the availability of the assessment and the findings to the public.

FOR THE DIRECTOR:

G. H. B. Shaffer

G. H. B. SHAFFER
RADM, USN
Deputy Director
(Operations & Administration)

2 Enclosures:
as

APPENDIX E-5

Finding of No Significant Impact

1. NAME OF PROPOSED ACTION

1. MILL RACE High-Explosive Test

2. DESCRIPTION OF PROPOSED ACTION

Field Command, Defense Nuclear Agency, proposes to conduct a high explosive test program 3.5 miles south of the Trinity Complex, White Sands Missile Range (WSMR), New Mexico to record blast and shock phenomena; record damage to weapons, shelters, and systems; record effects of combined blast and thermal phenomena; and increase the weapons effects data base. The proposed plan is to detonate a charge of explosives equivalent to 500 tons of TNT, which would simulate the blast and shock from a 1-kt nuclear surface burst.

Following the test the rubble will be removed; temporary structures and recoverable cabling will be salvaged and removed; and the crater filled. Revegetation will be provided as deemed necessary by the WSMR Facility Engineer. Alternate locations were considered but were discarded because of the availability of the required geologic characteristics at WSMR. Further, the proposed site is remote from population centers and is located on a national range dedicated to large scale testing.

3. ANTICIPATED ENVIRONMENTAL EFFECTS

The proposed construction and test bed will result in the temporary disturbance of about 120 acres of land. The effects of the explosion include airblast, thermal, noise, ground shock, crater formation, ejecta, missiles, and chemical by-products. Airblast dominates the other explosion phenomena. Damage or destruction of plants and animals (mostly rodents and lizards) can be expected within 2000 feet from the explosion of the 600 ton ANFO charge. Ground level dust and other air pollutants from the diffusion of the explosion cloud will be well within the most restrictive air quality standards. No endangered species will be affected by the program. Archeological sites will be protected.

4. FINDING AND CONCLUSION

The proposed action will not significantly affect the quality of the human environment and is not controversial. Therefore, an Environmental Impact Statement will not be prepared for the proposed action.

APPENDIX E-6

Defense Nuclear Agency
Washington, D. C. 20305

Finding of No Significant Impact

and

Environmental Assessment

for

High-Explosive Field Test

MILL RACE

JANUARY 1981

APPROVED

FOR THE DIRECTOR:

G. H. B. SHAFFER
RADM, USN
Deputy Director
(Operations & Administration)

APPENDIX F

PUBLIC AFFAIRS PLAN

1 June 1981

PUBLIC AFFAIRS PLAN

MILL RACE HIGH EXPLOSIVE TEST PROGRAM

A. SITUATION:

1. MILL RACE is a large scale, high explosive weapons effect field test sponsored by the Defense Nuclear Agency (DNA). Execution of the test is currently scheduled for September 1981. Detonation of 600 tons of an ammonium nitrate-fuel oil (ANFO) mixture will provide simulated nuclear airblast and ground motion environment for numerous experiments to be conducted by Department of Defense, other government agencies, and selected foreign countries. A simulated nuclear thermal environment for a selected number of the experiments will also be provided by using a liquid oxygen (LOX) and aluminum powder fuel disbursed through a high pressure nozzle system.

2. MILL RACE is one of a series of high explosive programs to test equipment and structures at full scale. Other recent tests include D. E THROW at White Sands Missile Range in 1976 and MISERS BLUFF at Planet Ranch, Ariz., in 1978. Data obtained from high explosive tests may be compared with previously reported nuclear effects data and may serve to validate the predictions of a variety of nuclear effects computer codes, thereby expanding the knowledge of nuclear weapons effects.

3. The MILL RACE test will be conducted in the northern portion of White Sands Missile Range, N.M., a national range operated by the US Army. The test bed is located approximately 3.5 miles from where the world's first atomic device was detonated July 16, 1945. The area offers an ideal test bed for high

explosive testing because the terrain is very flat, different geology conditions exist and population centers are far enough away to minimize blast damage, but near enough for good logistics support. Stallion Range Center located within the northern boundaries of WSMR, is the nearest populated area. San Antonio, N.M., is the nearest off-range inhabited community.

B. The primary objective of the MILL RACE test is to provide an airblast and ground shock environment for Department of Defense weapons systems, communications equipment, aircraft, vehicles and a variety of structures. A secondary objective is to provide a thermal environment (in addition to airblast) for several experiments. Supporting objectives are: (1) record the airblast and ground shock environment, (2) record damage to DOD sponsored experiments, (3) record combined thermal/blast effects, and (4) increase the weapons effects data base.

C. SCOPE:

This plan is applicable to all Department of Defense agencies and activities participating in or supporting the MILL RACE High-Explosive Field Test program.

D. OBJECTIVES:

To gain and preserve public understanding and acceptance of the MILL RACE High-Explosive Test program, and to increase and enhance public understanding of the necessity of the tests and the importance of White Sands Missile Range's defense testing mission.

E. PURPOSE:

To announce policies, objectives and responsibilities, and to provide guidance for the conduct of Public Affairs activities in connection with the MILL RACE High Explosive Test program.

F. EXECUTION:

1. Concept of Operations.

a. Since a number of government agencies, government-sponsored companies, and foreign governments will be involved in the MILL RACE test, close coordination and cooperation between commands, agencies, and companies will be required to assure the complete success of the information effort associated with this test.

b. The Commanding General of White Sands Missile Range is responsible for conducting public information and community relations activities designed to achieve public understanding of the need for the tests and the absence of hazard in connection with the MILL RACE High Explosive test. Coordination and release of information on the scheduling, postponement, or completion of any particular test or project phase will be with the Range Commander (Commanding General, White Sands Missile Range). (See sample releases at Annexes A & B).

The WSMR Commander will be solely responsible for release of information concerning matters involving mishaps or matters pertaining to ground safety occurring on WSMR. Release of information on the success or failure of any particular test will be coordinated with the Range Commander. Releases include articles, photographs, motion picture footage, and oral presentations.

c. The above requirement stems from a Department of Defense (DOD) Directive which states, in part, "The release of public information regarding the safety aspects of (testing) operations requires special attention. The possible hazards and margins of safety are matters of public concern. It is essential, therefore, that such information be released to the public by the single source that is most knowledgeable."

2. Plan of Operations.

a. The White Sands Missile Range Commander will ensure that, for public affairs purposes, there is continuous liaison between WSMR and the DNA Project Officer, Test Group Director, and Technical Director in order that maximum information support, within the capabilities of the WSMR Public Affairs Office, can be provided.

b. The WSMR Public Affairs Office will ensure the continuation of public information and community relations programs designed to allay public apprehension as to possible hazards and margins of safety during all phases of the MILL RACE High Explosive Test program.

c. Based on past experience with similar type projects, including DICE THROW in the fall of 1976, the public information effort will consist of a series of news releases and announcements detailing various phases of the test program, monitoring public attitudes, and answering press queries. Sending WSMR and DNA representatives into neighboring communities (Socorro and San Antonio, N.M.) to address civic organizations and groups, and community leaders, is initially considered unnecessary. Depending on public reaction to initial news releases, face-to-face discussion may become necessary before the test.

d. It is essential that timely announcements be given the press before and following the test in an effort to avoid speculation and apprehension on the part of the public. To this end, a minimum of two press releases will be made, with the first release date set approximately two months before the actual test date. The releases will be made to coincide with publication dates of the Socorro Defensor/Chieftain, Carrizozo Lincoln County News, both weekly papers in the vicinity of the test bed. This can be accomplished by telephonic reports just prior to news deadline for the weeklies. At the same time releases will be given to the wire services (AP and UPI, Albuquerque) and electronic media to assure the broadest dissemination of the announcements. The announcements or releases also will be provided (mail) to the New Mexico congressional delegation and governor's office.

e. Press announcements detailing mishaps or serious injuries to project personnel will be provided by the WSMR Public Affairs Office as soon as possible following the incident and in accordance with current directives.

f. Still and motion (television) film must also be made available to the press and television news outlets in a timely fashion.

g. An observation point, capable of handling 15 to 20 press and electronic media representatives, should be included in construction plans. Either a natural or man-made knoll or suitable viewing spot from a static "low-boy" trailer should be considered. Portable latrines should be available nearby.

G. COORDINATION.

Direct communication through public affairs channels for the purpose of effecting continuous coordination between all participating or supporting agencies and commands is authorized.

H. ATTACHMENTS:

The following inclosures are intended as models for the release of information under the circumstances indicated:

Inclosure 1 - - PRE-TEST ANNOUNCEMENT

Inclosure 2 - - ANNOUNCEMENT OF TEST POSTPONEMENT

PRE-TEST ANNOUNCEMENT

WHITE SANDS MISSILE RANGE, N.M., (date) - - A high explosive test, designed to simulate a nuclear blast's shock and thermal effects, is scheduled to be conducted at White Sands Missile Range (date).

The simulated nuclear blast will be achieved by detonating 600 tons of an ammonium nitrate and fuel oil mixture. The test site is located in the northern portion of White Sands. Objectives of the controlled explosion are to determine effects a nuclear blast could have on various military equipment and structures. Of course, no nuclear radiation will be present since the explosion will be generated by non-nuclear materials.

The test is scheduled for (time) and residents of San Antonio, Socorro, Bingham and area ranches will be able to hear the blast. The sound may also carry as far as the Truth or Consequences and Carrizozo areas.

The test, known as MILL RACE, is the latest in a series of high explosive tests to be sponsored by the Defense Nuclear Agency. Previous high explosive tests were conducted at White Sands in 1976 and in Arizona in 1978.

ANNOUNCEMENT OF POSTPONEMENT

WHITE SANDS MISSILE RANGE, N.M., (date) - - Officials at White Sands Missile Range have announced the temporary postponement of a high explosive test that had been scheduled for (date).

According to spokesmen for the range and the Defense Nuclear Agency, the test sponsor, the reason for delaying the test is (____).

The test has been rescheduled for (date and time).

To conduct the test, which is designed to simulate the blast and thermal effects of a nuclear explosion on military equipment and structures, 600 tons of an ammonium nitrate and fuel oil mixture will be detonated.

The test site is located in the northern portion of the range. Residents of San Antonio, Socorro, Bingham and area ranches will be able to hear the blast. The sound may also carry as far as the Truth or Consequences and Carrizozo areas.

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APPENDIX G
SITE SELECTION INFORMATION

G-1. Site Selection Information

G-2. MILL RACE Site Characterization

APPENDIX G-1

RESULTS OF SEISMIC SURVEYS AND

DRILLING FOR MILL RACE TEST SITE SELECTION

R. Reinke

During the period 18 through 20 August 1980, the AFWL/NTE seismic crew conducted a total of 8 seismic refraction surveys in an area to the south of the TRINITY and DICE THROW test sites in the Northern Region of White Sands Missile Range. The purpose of these surveys was to establish the depth to water table and/or major reflector and to obtain subsurface seismic velocities at several potential MILL RACE test sites. During the last half of September NMERI/CERF drilled holes at two of these potential ground zeroes in order to verify depth to water table and to obtain further subsurface geologic information.

All of the seismic lines were approximately 640 meters (2110 feet) in length and composed of 24 geophones. One-half of each line was made up of 12 geophones spaced at approximately 15 meters (50 feet), the remaining 12 geophones were spaced at 34 meters (110 feet). This configuration was used in order to obtain fair resolution at the shallower depths while retaining a total depth penetration on the order of 150 meters (500 feet). The geophones used were Walker Hall-Sears type Z-3 with a natural frequency of 4.5 hertz. The geophones were recorded by an SIE RS-44 24 channel seismic amplifier. Kinepak loads of up to 11 pounds provided the seismic source. The lines were located in the field by means of vehicle odometer and Brunton compass. All lines were reversed (shots recorded on both ends). Locations of the survey lines are shown in Figure 1.

Overall recording conditions were good with minimal wind noise on most records. Overall first arrival data quality was good. Travel times were picked to the nearest millisecond and plotted versus range as shown in Figures 2 through 9. "Eyeball" fits to the travel times were then made and interface depths were calculated as shown on the travel time curves. No attempt was made to correct for surface elevation differences or for dipping layers, however, for the purpose of determining the approximate depth to the major reflector these factors are not of major significance.

Reference 1 reports the measured depth to water at the McDonald Ranch Well in Section 5 as 104 meters (342 feet). In an effort to obtain a tiepoint for the seismic surveys, refraction line 1 was placed immediately to the west of the McDonald Ranch Well. The travel time curves from this line are shown in Figure 2. These indicate a refractor with an average velocity near 3350 mps (11000 fps) at a depth of about 100 meters (328 ft). The relatively high velocity of this refractor suggests that it is composed of limestone or sandstone rather than saturated alluvium. The total depth of the McDonald Ranch Well as

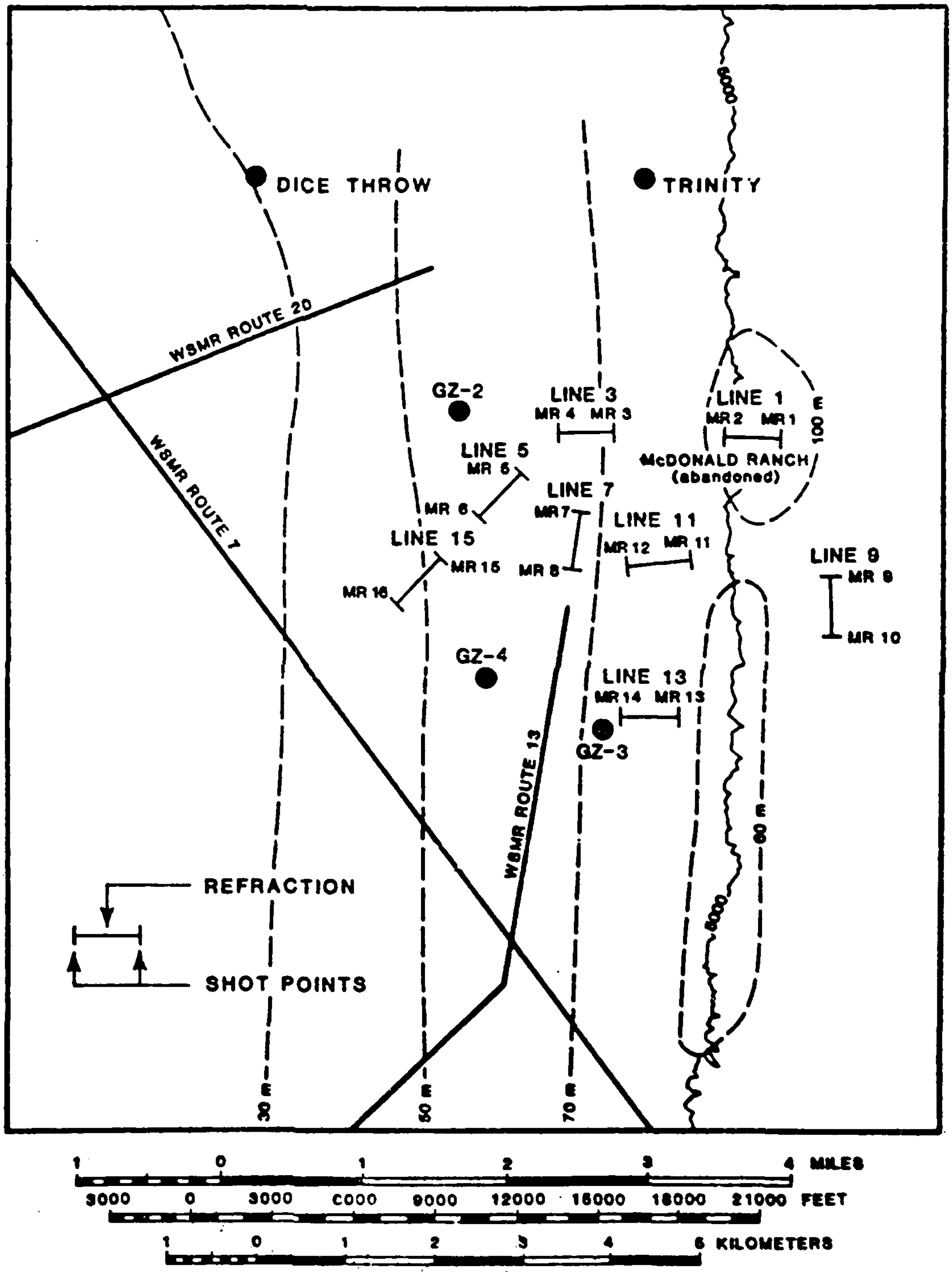

DICE THROW
TRINITY
WSMR ROUTE 20
WSMR ROUTE 7
WSMR ROUTE 13
GZ-2
GZ-4
GZ-3
LINE 3
MR 4 MR 3
LINE 1
MR 2 MR 1
McDONALD RANCH
(abandoned)
LINE 5
MR 5
MR 6
LINE 7
MR 7
MR 8
LINE 11
MR 12 MR 11
LINE 15
MR 15
MR 16
LINE 9
MR 9
MR 10
LINE 13
MR 14 MR 13
REFRACTION
SHOT POINTS
30 m
50 m
70 m
80 m
100 m
5000
1 0 1 2 3 4 MILES
3000 0 3000 C000 9000 12000 15000 18000 21000 FEET
1 0 1 2 3 4 5 KILOMETERS

Figure 1

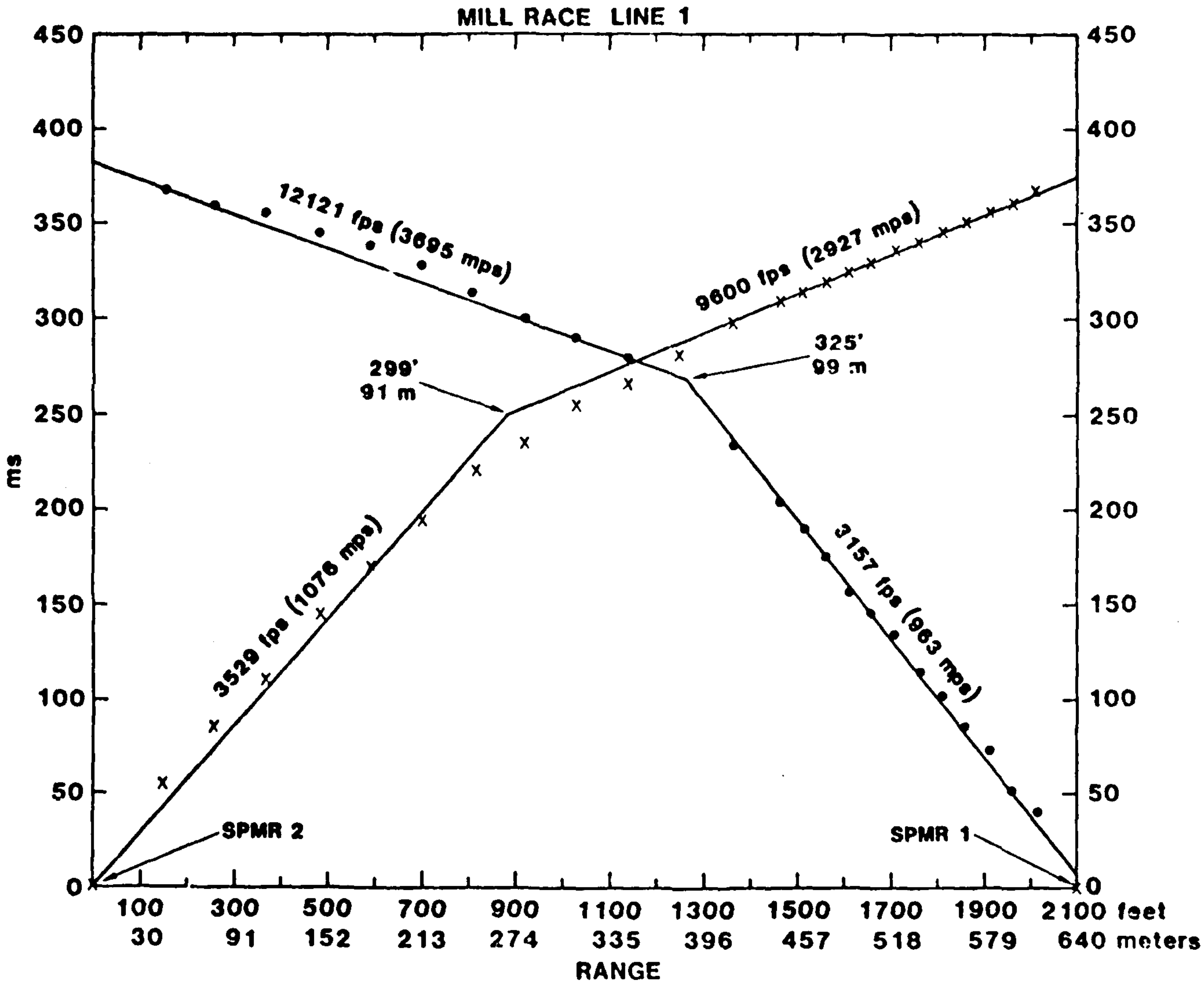

MILL RACE LINE 1
12121 fps (3695 mps)
9600 fps (2927 mps)
299'
91 m
325'
99 m
3529 fps (1076 mps)
3157 fps (963 mps)
SPMR 2
SPMR 1
ms
0
50
100
150
200
250
300
350
400
450
100 300 500 700 900 1100 1300 1500 1700 1900 2100 feet
30 91 152 213 274 335 396 457 518 579 640 meters
RANGE

Figure 2

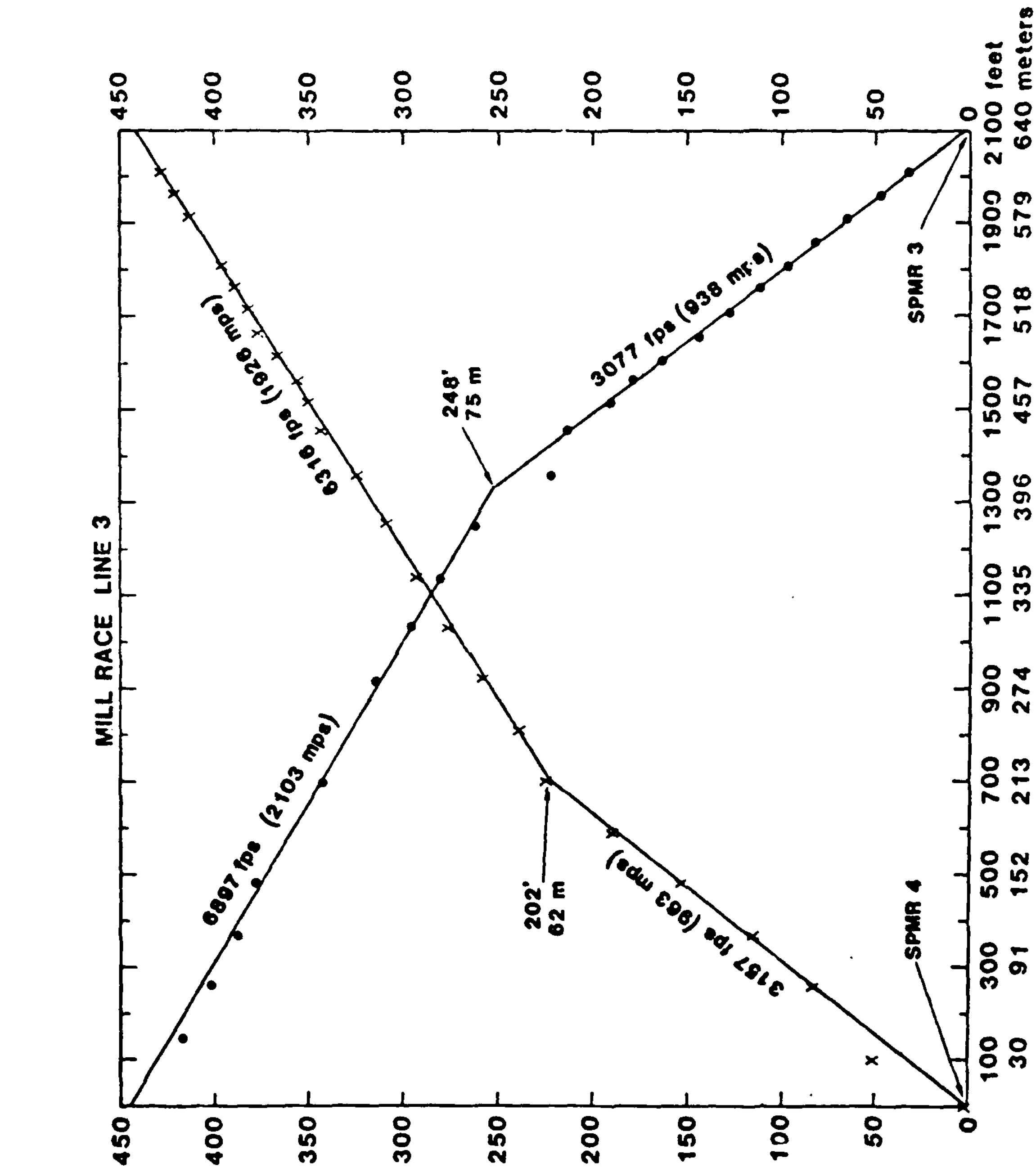

MILL RACE LINE 3
ms
RANGE
feet
meters
6897 fps (2103 mps)
6319 fps (1926 mps)
3077 fps (938 mps)
3157 fps (963 mps)
248'
75 m
202'
62 m
SPMR 3
SPMR 4
0
50
100
150
200
250
300
350
400
450
0
100
300
500
700
900
1100
1300
1500
1700
1900
2100
30
91
152
213
274
335
396
457
518
579
640

Figure 3

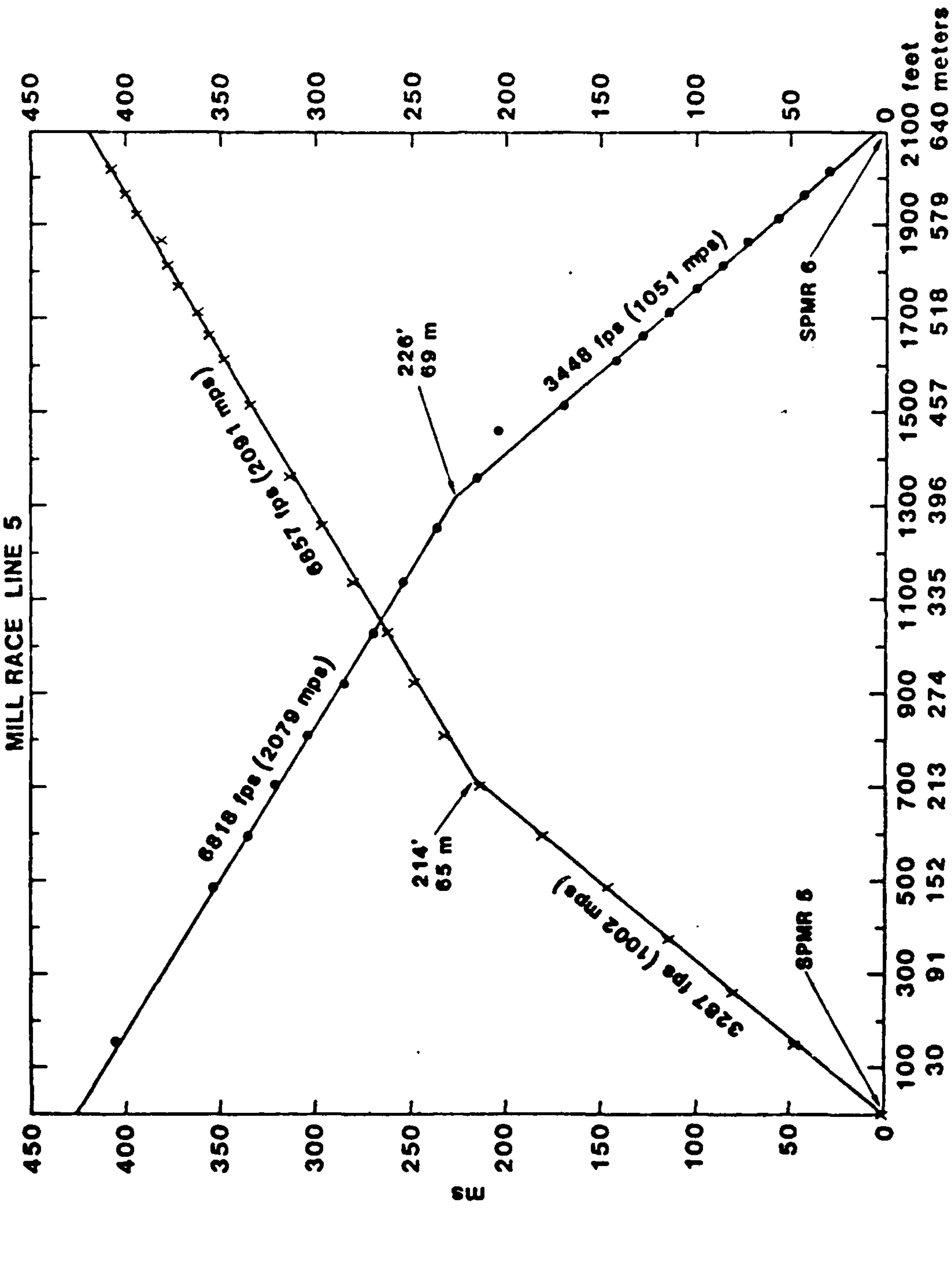
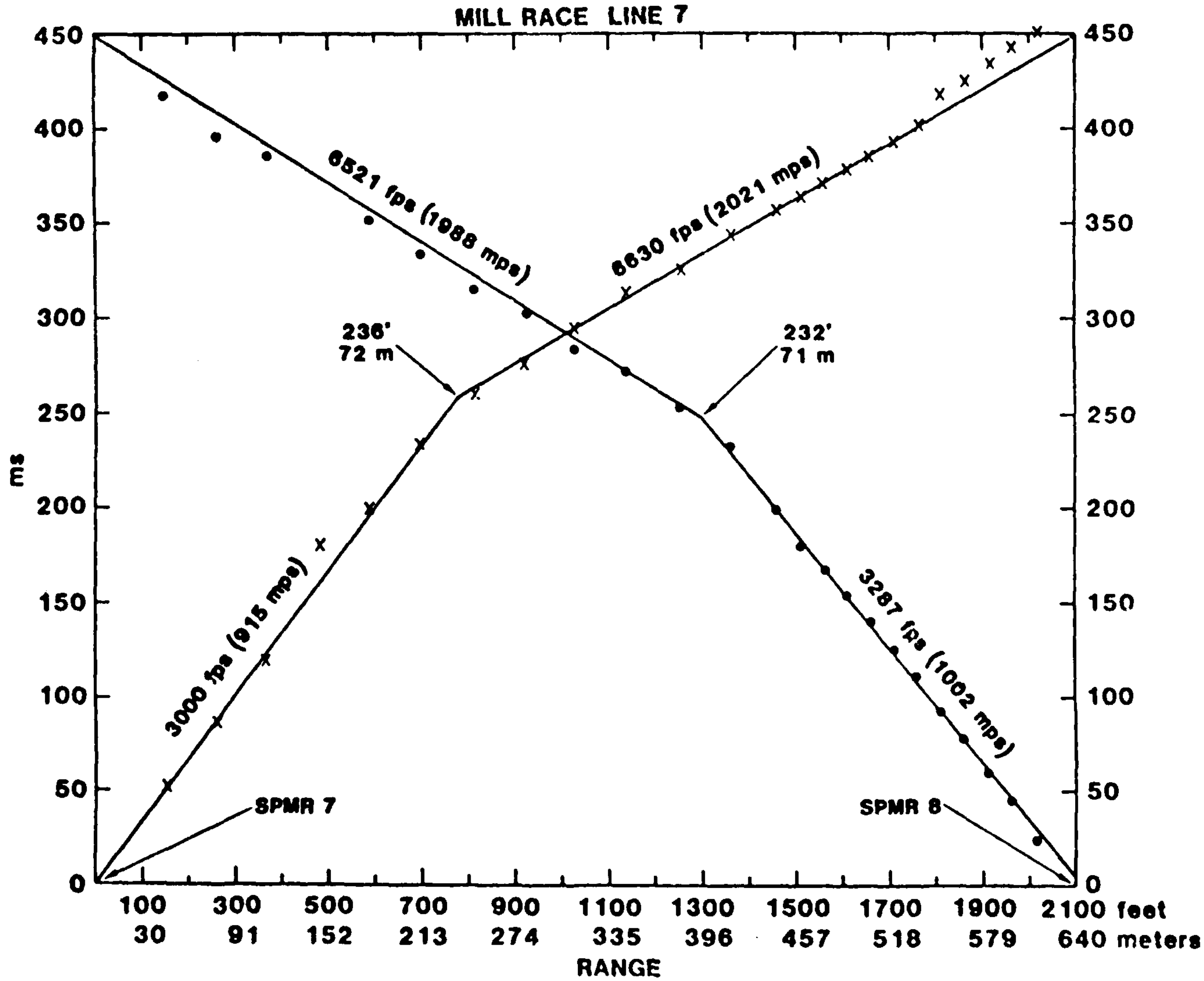

MILL RACE LINE 5
ms
450
400
350
300
250
200
150
100
50
0
6818 fps (2079 mps)
6857 fps (2091 mps)
3448 fps (1051 mps)
3287 fps (1002 mps)
226'
69 m
214'
65 m
SPMR 5
SPMR 6
0 100 300 500 700 900 1100 1300 1500 1700 1900 2100 feet
0 30 91 152 213 274 335 396 457 518 579 640 meters
RANGE

Figure 4



MILL RACE LINE 7
ms
RANGE
feet
meters
6521 fps (1988 mps)
6630 fps (2021 mps)
3000 fps (915 mps)
3287 fps (1002 mps)
236'
72 m
232'
71 m
SPMR 7
SPMR 8

Figure 5

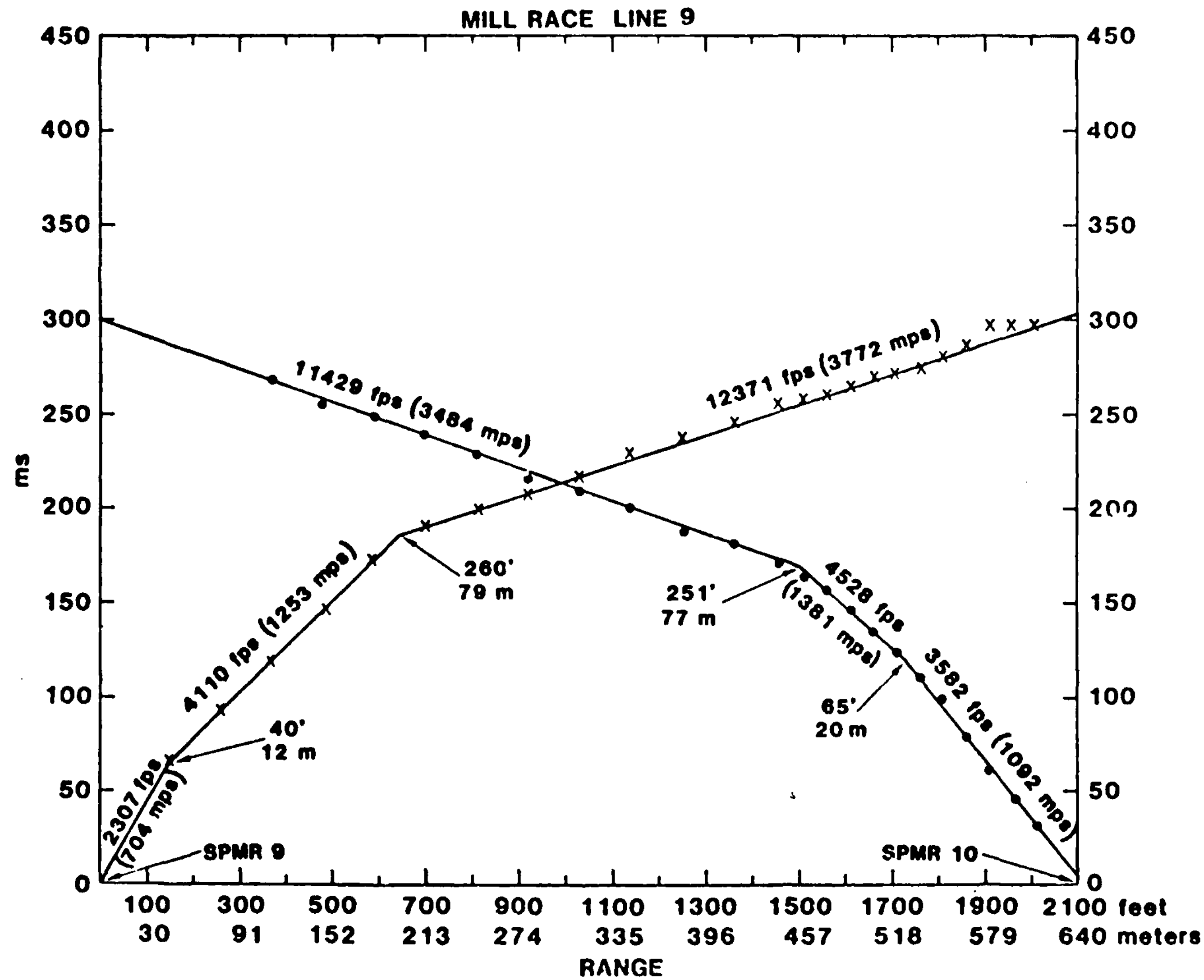
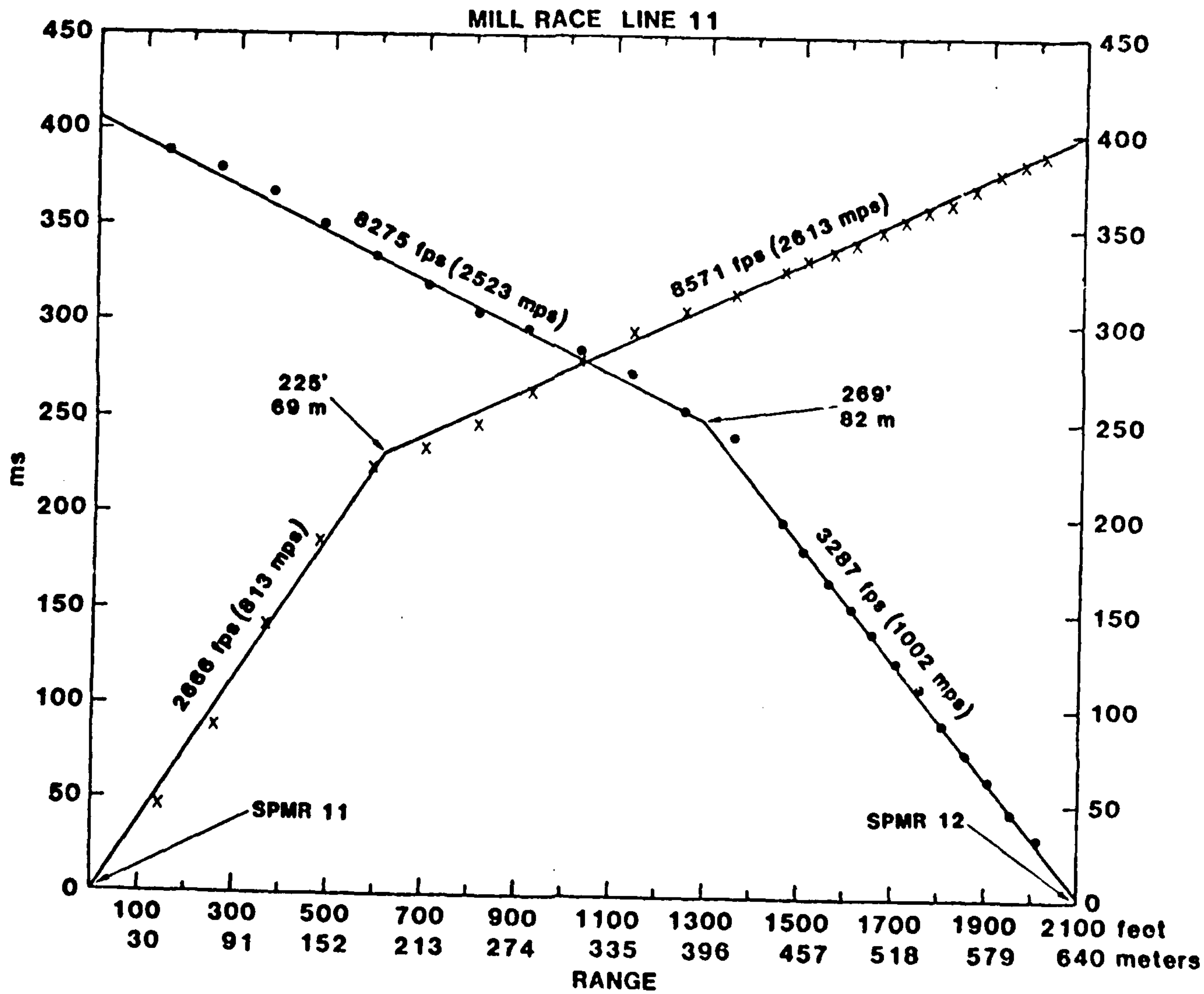

MILL RACE LINE 9
ms
0
50
100
150
200
250
300
350
400
450
11429 fps (3484 mps)
12371 fps (3772 mps)
2307 fps (704 mps)
4110 fps (1253 mps)
4528 fps (1381 mps)
3582 fps (1092 mps)
260' 79 m
251' 77 m
40' 12 m
65' 20 m
SPMR 9
SPMR 10
100 300 500 700 900 1100 1300 1500 1700 1900 2100 feet
30 91 152 213 274 335 396 457 518 579 640 meters
RANGE

Figure 6



MILL RACE LINE 11
ms
450
400
350
300
250
200
150
100
50
0
8275 fps (2523 mps)
8571 fps (2613 mps)
2666 fps (813 mps)
3287 fps (1002 mps)
225'
69 m
269'
82 m
SPMR 11
SPMR 12
100 300 500 700 900 1100 1300 1500 1700 1900 2100 feet
30 91 152 213 274 335 396 457 518 579 640 meters
RANGE

Figure 7

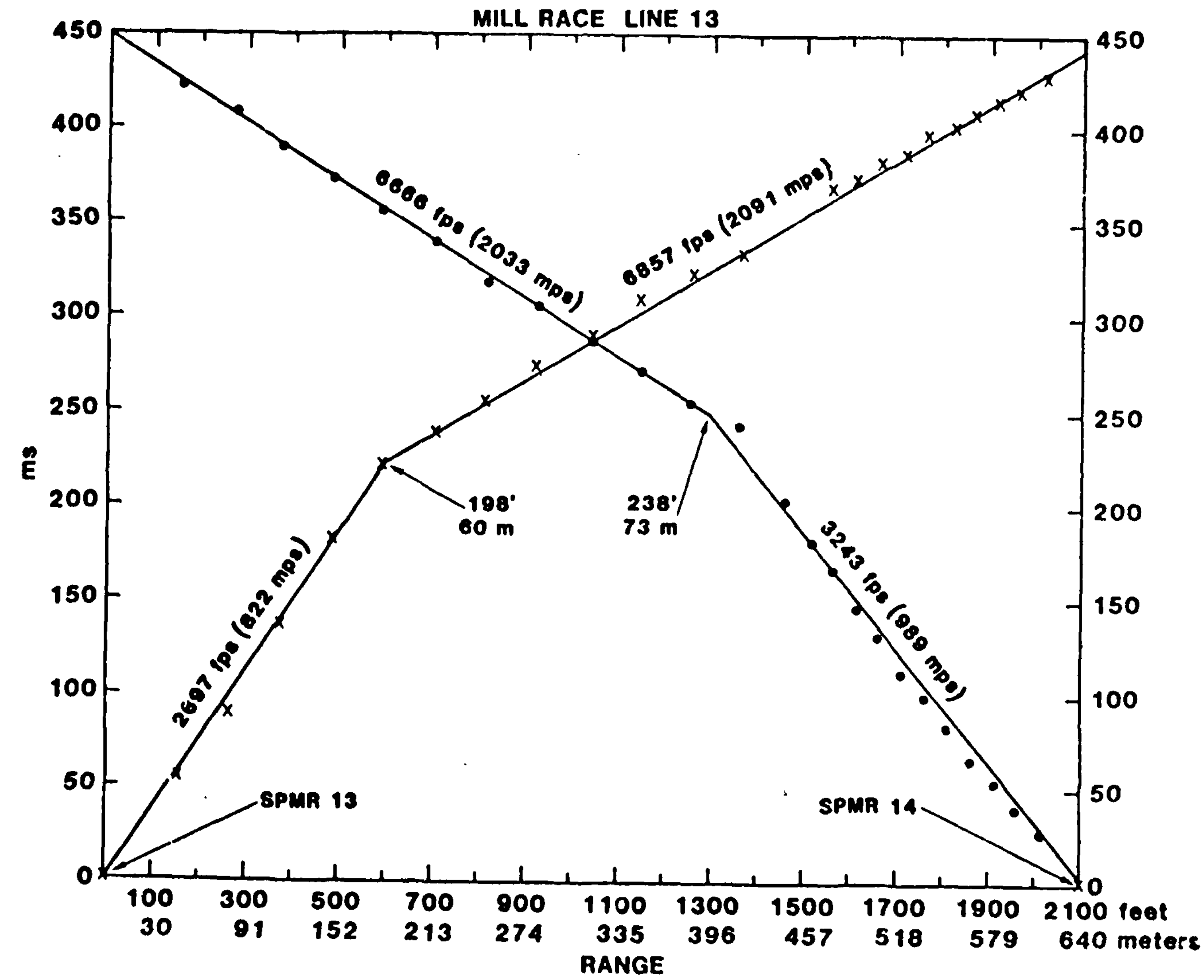
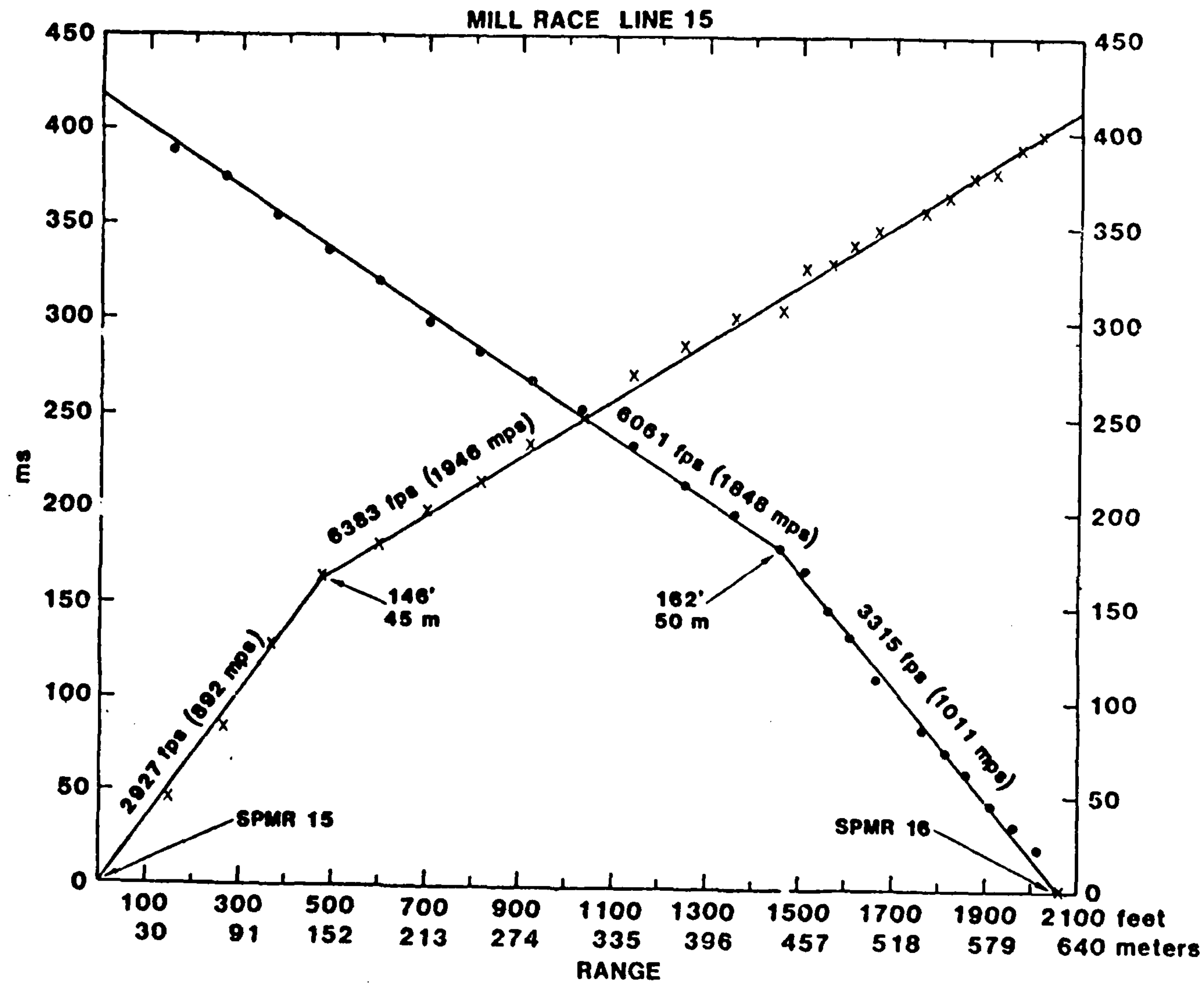

MILL RACE LINE 13
ms
6666 fps (2033 mps)
6857 fps (2091 mps)
2697 fps (822 mps)
3243 fps (989 mps)
198'
60 m
238'
73 m
SPMR 13
SPMR 14
100 300 500 700 900 1100 1300 1500 1700 1900 2100 feet
30 91 152 213 274 335 396 457 518 579 640 meters
RANGE

Figure 8



MILL RACE LINE 15
ms
450
400
350
300
250
200
150
100
50
0
2927 fps (892 mps)
6383 fps (1946 mps)
6061 fps (1848 mps)
3315 fps (1011 mps)
146'
45 m
162'
50 m
SPMR 15
SPMR 16
100 300 500 700 900 1100 1300 1500 1700 1900 2100 feet
30 91 152 213 274 335 396 457 518 579 640 meters
RANGE

Figure 9

reported by Reference 1 is 110 meters (360 feet). This is likely the depth at which rock was encountered meaning that the layer of saturated sediments above the water is only a few meters thick and would not be detected with the geophone spacing used. The middle of seismic line 1 where the computed depths apply is topographically about 10 meters lower than the well elevation. This may explain the shallower interface depths indicated by refraction line 1.

The remainder of the refraction lines were scattered about the area south of TRINITY in an effort to obtain some idea of the variation of depth to major reflector within the area. In addition to line 1 discussed previously, line 9 also encountered a high velocity major reflector, 3660 mps (12000 fps), which is apparently composed of rock. All of the other lines, with the exception of line 11 which indicated a velocity that is somewhat high for saturated sediments alone, indicate that the first major reflector is composed of saturated material. Apparently a major North - South fault roughly follows the 1524-meter (5000-foot) contour line which passes just to the west of McDonald Ranch. To the east of this fault, bedrock is relatively shallow, to the west, the bedrock becomes much deeper but the water table becomes shallower.

All of the lines except for line 15 indicated at least a 60-meter (200-foot) depth to major reflector. Based on the seismic lines, and other information, very approximate depth to reflector contours have been drawn on the map in Figure 1. A nominal 60-meter (200-foot) depth to reflector can likely be obtained anywhere in the area east of shotpoint MR6, to the west of the 1524-meter (5000-foot) topographic contour line, to the south of the TRINITY site and to the north of refraction line 13.

Much of this area of WSMR below an elevation of 1463 meters (4800 feet) was covered by Lake Trinity during the Pleistocene (References 2 and 3). When the lake evaporated, large amounts of gypsum deposits were left behind. The avoidance of the undesirable effects of these deposits upon some of the MILL RACE experiments (cratering and close-in ground motion effects), makes it mandatory that the MILL RACE GZ be located at as high an elevation (meaning as far to the east as possible) as possible considering the topographic requirements of some of the other experiments.

After a cursory field examination of the area Field Command Defense Nuclear Agency (FCDNA) personnel selected 4 potential GZ's. Two of the sites were thrown out immediately because of topographic and geologic considerations leaving GZ-3 and GZ-4 as shown on the map in Figure 1. As seen in Figure 1, GZ-3 lies a short distance to the west of refraction line 13. The computed depth to water table at GZ-3 from the seismic information is 73 meters (238 feet) as seen in Figure 8. In order to verify this depth and positively identify the observed refractor as the water table, NMERI/CERF drilled a borehole at GZ-3 to a depth of 79 meters (260 feet). The drilling log is shown in Figure 10. The water table was logged at a depth of 75 meters (246 feet) confirming the seismic

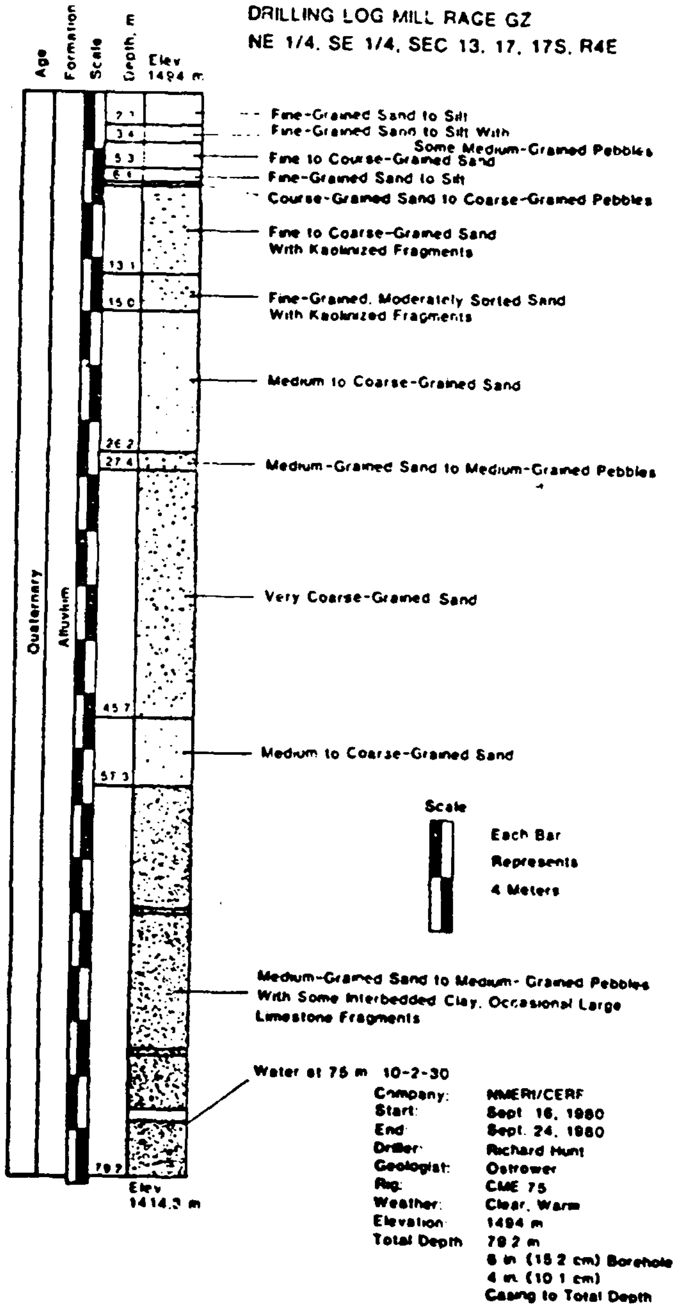
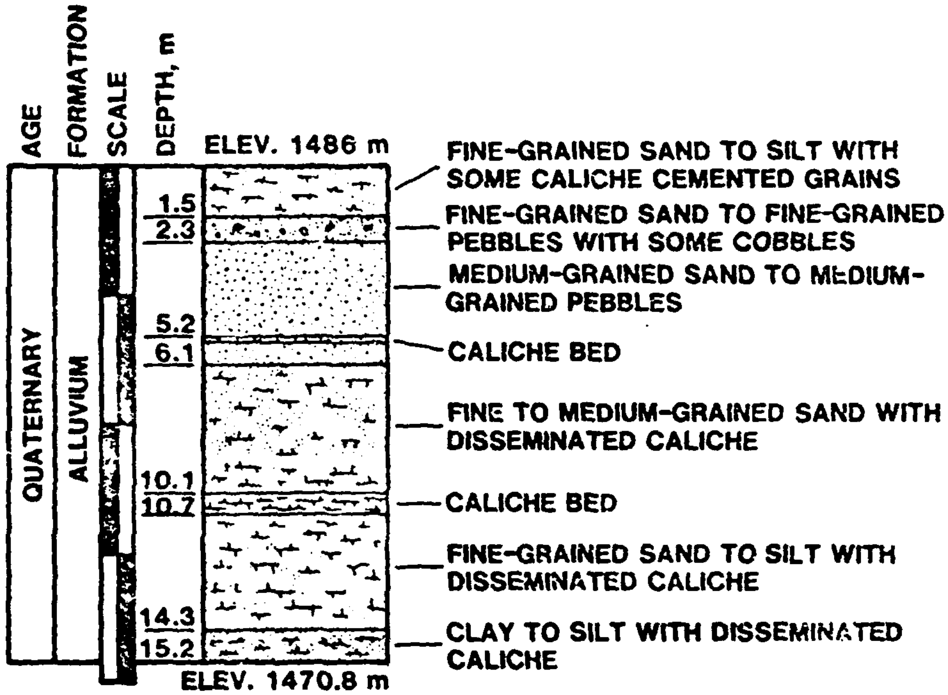
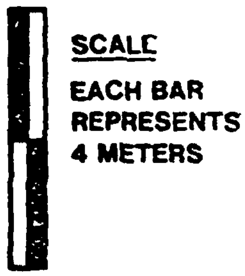

DRILLING LOG MILL RAGE GZ
NE 1/4, SE 1/4, SEC 13, 17, 17S, R4E
Age
Formation
Scale
Depth, m
Elev 1494 m
Quaternary
Alluvium
Fine-Grained Sand to Silt
Fine-Grained Sand to Silt With Some Medium-Grained Pebbles
Fine to Course-Grained Sand
Fine-Grained Sand to Silt
Course-Grained Sand to Coarse-Grained Pebbles
Fine to Coarse-Grained Sand With Kaolinized Fragments
Fine-Grained, Moderately Sorted Sand With Kaolinized Fragments
Medium to Coarse-Grained Sand
Medium-Grained Sand to Medium-Grained Pebbles
Very Coarse-Grained Sand
Medium to Coarse-Grained Sand
Scale
Each Bar Represents 4 Meters
Medium-Grained Sand to Medium-Grained Pebbles With Some Interbedded Clay, Occasional Large Limestone Fragments
Water at 75 m 10-2-30
Company: NMERI/CERF
Start: Sept 16, 1980
End: Sept. 24, 1980
Driller: Richard Hunt
Geologist: Ostrower
Rig: CME 75
Weather: Clear, Warm
Elevation: 1494 m
Total Depth: 79.2 m
6 in (15.2 cm) Borehole
4 in (10.1 cm) Casing to Total Depth
Elev 1414.3 m

Figure 10

results. As seen in Figure 10, the soil profile above the water level is relatively uniform and composed mainly of medium to coarse grained sand. No caliche beds were observed. NMERI/CERF also drilled a shallow [15-meter (50-foot)] hole at the GZ-4 site. This location is somewhat more attractive to test engineering personnel for topographic and logistic reasons. The 15-meter (50-foot) hole was drilled there in order to determine the presence or absence of lake deposits. While no lake deposits as such were encountered, the drilling log, as shown in Figure 11, does indicate that the soil profile here is quite complicated relative to that at GZ-3. Caliche beds are also present at this location. Because the geologic conditions at GZ-4 would make analysis of the cratering and close-in ground motion data extremely difficult, it is strongly recommended that GZ-3 be the site of the MILL RACE detonation. The question of depth to reflector at GZ-4 has not yet been answered. If for some reason it proves impossible to use GZ-3, it will be necessary to perform both seismic surveys and deep drilling at GZ-4 in order to obtain this information.

DRILLING LOG MILL RACE GZ-4
SW 1/4, SE 1/4, SEC 11, T7S, R4E





COMPANY:	NMERI/CERF
START:	SEPT. 25, 1980
END:	SEPT. 26, 1980
DRILLER:	RICHARD HUNT
GEOLOGIST:	OSTROWER
RIG:	CME 75
WEATHER:	CLOUDY, WINDY
ELEVATION:	1486 m
TOTAL DEPTH:	15.2 m

Figure 11

REFERENCES

1. Weir, James E., Jr, "Geology and Availability of Ground Water in the Northern Part of the White Sands Missile Range and Vicinity of New Mexico," Geological Survey Water - Supply Paper 1801, 1965.

2. Neal, James T., "Pleistocene Lake Trinity, A Sulfate Basin in the Northern Jornado Del Muerto, New Mexico," Abstracts with Programs 1976 Annual Meeting Geological Society of America, pp 1026-1027.

3. James T. Neal Personal Communications.

APPENDIX G-2

A SUMMARY OF THE GEOLOGIC CHARACTERIZATION OF THE MILL RACE SITE, WSMR

David A. Bedsun

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June 1981

Letter Report for Period September 1980 through June 1981

Work performed at the Eric H. Wang Civil Engineering Research Facility Kirtland Air Force Base, New Mexico 87117

Prepared for
AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
Kirtland Air Force Base, New Mexico

INTRODUCTION

During the fall of 1980 geologic site characterization was initiated at the Mill Race test site at White Sands Missile Range (WSMR) (Figure 1). That study was based on logs of 2 deep boreholes and 3 exploratory trenches (Figure 2). The results were reported by Mark Ostrower (NMERI) in a quick look report to the Air Force (Mill Race Site Characterization, January 1981).

In May 1981 grounding rod boreholes were drilled in the north (5 boreholes) and in the south (7 boreholes) instrumentation parks (Figure 1). One borehole in each park was logged. An additional 4 boreholes were drilled in the Mill Race testbed to provide subsurface information for the placement of NMERI structures and sand columns.

This is a summary report of all geologic characterization at or near the Mill Race test site. Appendix A contains the logs and results of laboratory testing of samples taken from the testbed. Appendix B contains the logs of other NMERI borings in the area.

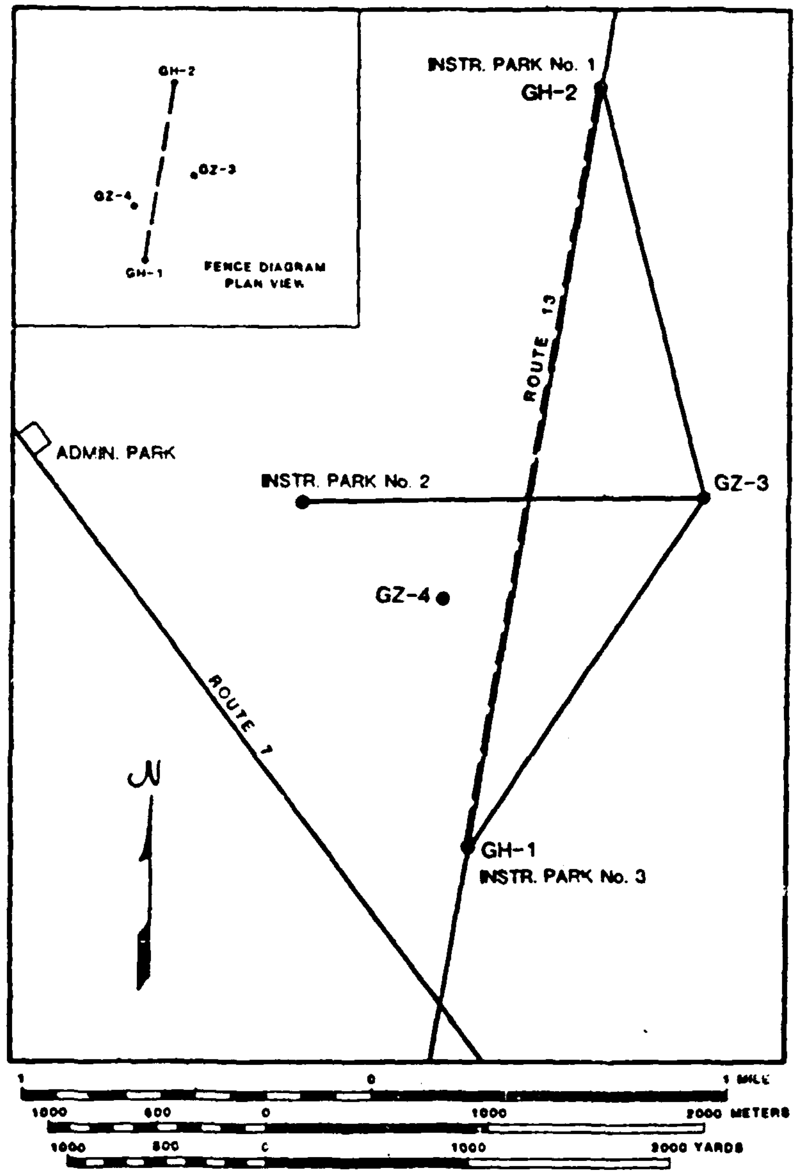


Figure 1. Location of boreholes in the area of MILL RACE.

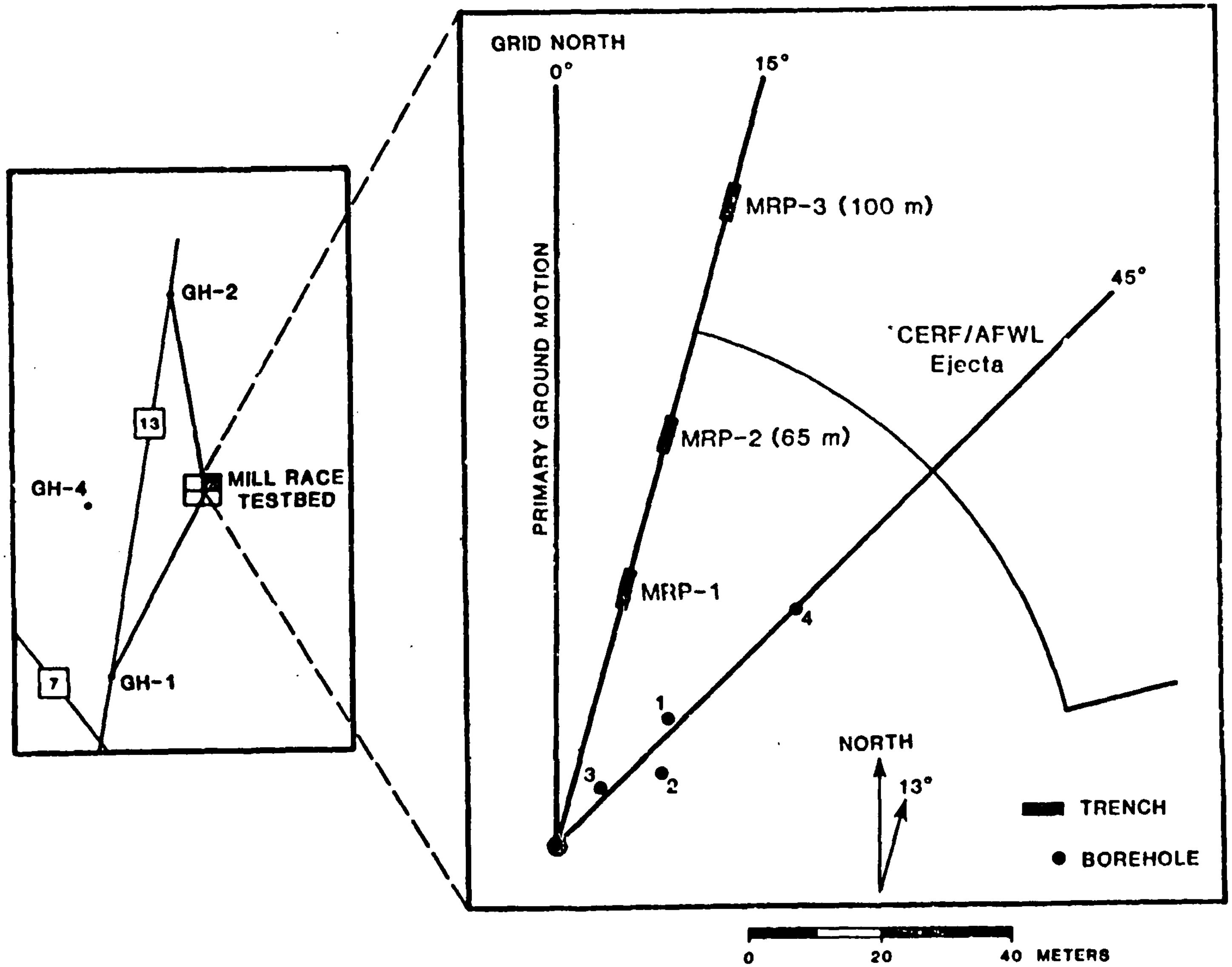


Figure 2. Location of exploration pits and boreholes at the northeast corner of the MILL RACE testbed.

GENERAL GEOLOGY

Figure 1 shows the location of the Mill Race testbed, administrative park, instrument parks, and plan view trace of a generalized cross section.

The surface of the Mill Race site slopes to the west at approximately one degree (Figure 1). Therefore, the mountains to the east provide most of the detritus for the Mill Race site. These mountains are composed of Pennsylvanian limestones, shales, sandstones, and Precambrian granites and metamorphic rocks.

Figure 3 is a generalized cross section connecting the north and south instrument parks along Route 13, which is a distance of approximately 2 miles. In general, the cross section indicates fair correlation between boreholes. Near surface silty-sands with caliche are underlain by alternating layers of coarse sand and silty gravels. The exception to this general pattern is borehole GZ-4 which also has the lowest surface elevation (4850 feet). A clayey-silt layer approximately 15 feet thick (ML shown in Figure 2) occurs at 35 feet below the surface. This layer was not encountered in any other borehole.

The depth to water was measured at 238 feet in borehole GZ-3 (Mill Race SGZ) in September 1980. This same depth to water was also recorded in May 1981, confirming it is the static water table value.

Table 1 summarizes sampling intervals and procedures for boreholes and trenches in the Mill Race area.

TESTBED GEOLOGY

Figure 2 shows the location of exploration trenches and boreholes on the Mill Race testbed. All boreholes and trenches are located in the northeast quadrant of the testbed (Figure 2).

Exploration trenches

Three trenches were dug to a depth of 11 feet on a line trending N15°E from borehole GZ-3. PIT MRP-1 was dug at a range of 130 feet northeast of

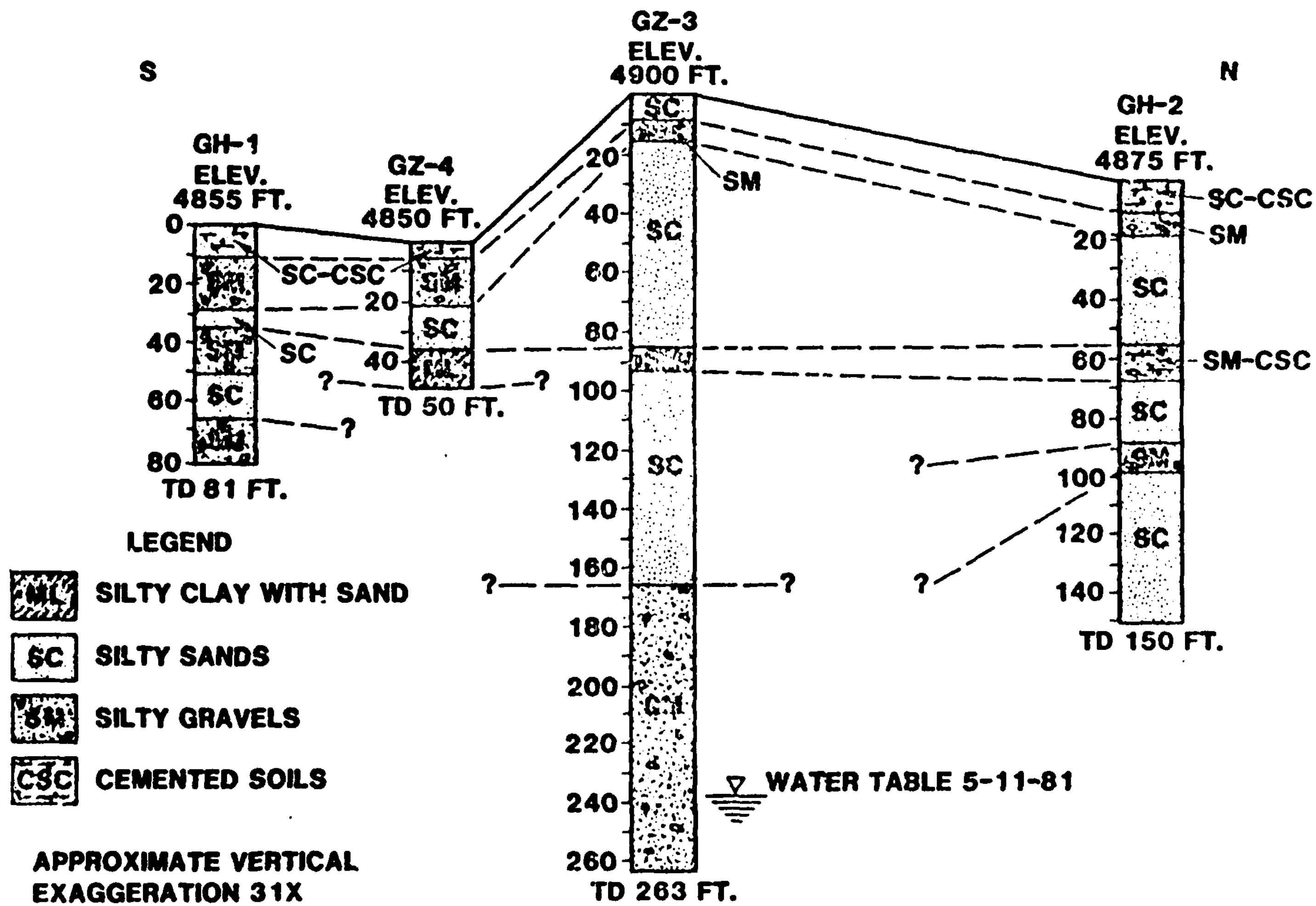


Figure 3. Generalized cross section along the road connecting the North and South Instrument Parks.

Table 1. Geologic sampling techniques used on MILL RACE boreholes and trenches.

depth, feet	Boreholes								Trenches		
	GH-2 north instr park	GH-1 south instr park	GZ-4	GZ-3	1 (Mill Race testbed)	2 (Mill Race testbed)	3 (Mill Race testbed)	4 (Mill Race testbed)	MRP-1	MRP-2	MRP-2
0 to 5	NS	AC	AC	AC	CSS	CSS	CSS	CSS	HS	HS	HS
5 to 10	SS	SS	AC	AC	CSS	CSS	CSS	CSS	HS	HS	HS
10 to 15	NS	AC	AC	AC	CSS	CSS	CSS	CSS			
15 to 20	SS	SS	AL	AL	CSS	CSS	CSS	CSS			
25	NS	AC	AC	AC							
30	SS	SS	AC	AC							
35	NS	AC	AC	AC							
40	SS	SS	AC	AC							
45	NS	AC	AC	AC							
50	SS	SS	AC	AC							
60	SS	SS		NS							
70	SS	SS		FC							
80	NS	SS		NS							
90	SS			FC							
110	SS			FC							
130	SS			FC							
150	SS			FC							
170				FC							
190				FC							
210				FC							
230				FC							
250				FC							

Sampler type and technique

AC - Auger cuttings
HS - Hand samples from trenches
SS - Split spoon
NS - No sample
CSS - continuous split spoon
FC - Drilling fluid cuttings

borehole GZ-3. Fine-grained windblown sand extends from the surface to a depth of 1 ft. From 1 ft to 6 ft, a massive, hard, white caliche layer is present. The upper and lower boundaries of the caliche are sharp. Coarse-grained sand and gravel underlie the caliche bed to at least a depth of 11 ft (the floor of the exploration pit). The sand and gravel contain some caliche coatings and scattered nodules of caliche.

Exploration pit MRP-2 was located at a range of 214 ft northeast of GZ-3. Fine grained windblown sand extends from the surface to a depth of 1.5 ft. The caliche layer extends from 1.5 to 8 ft and is nearly identical to the caliche found in pit MRP-1. Again, the upper and lower boundaries of the caliche are sharp. Below the caliche, coarse-grained sand and gravel extend from 8 ft to the floor of the trench (11 ft). As in pit MRP-1 the sand and gravel have minor coatings of caliche and scattered nodules of calicne.

Pit MRP-3 was located at a range of 328 ft from GZ-3. The fine-grained windblown sand extends from the surface to a depth of 1.5 ft. From 1.5 ft to 8.5 ft, caliche coatings on fine sand grains are common, although, the caliche is not massive as it is in pits MRP-1 and MRP-2. The upper boundary of the caliche zone is gradational, whereas the lower boundary with the underlying coarse-grained sand and gravel is sharp at 8.5 ft. The sand and gravel again have coatings of caliche and scattered nodules of caliche. Underlying the sand and gravel is a fine-grained sand with caliche coated grains. The boundary of these two units appears to be undulatory.

Figure 4 is a cross section from borehole GZ-3 to the 328 ft range along a line trending N15°E. The massive caliche was not encountered in borehole GZ-3. Therefore, it is most likely that the well developed caliche layer noted in pits MRP-1 and MRP-2 wedges out between borehole GZ-3 and pit MRP-1 (Figure 4).

Testbed boreholes

Four 20 foot deep boreholes were drilled along a line trending N45°E from borehole GZ-3 (Figure 2). Figure 5 is a cross section along this line from GZ-3 to the 164 ft range.

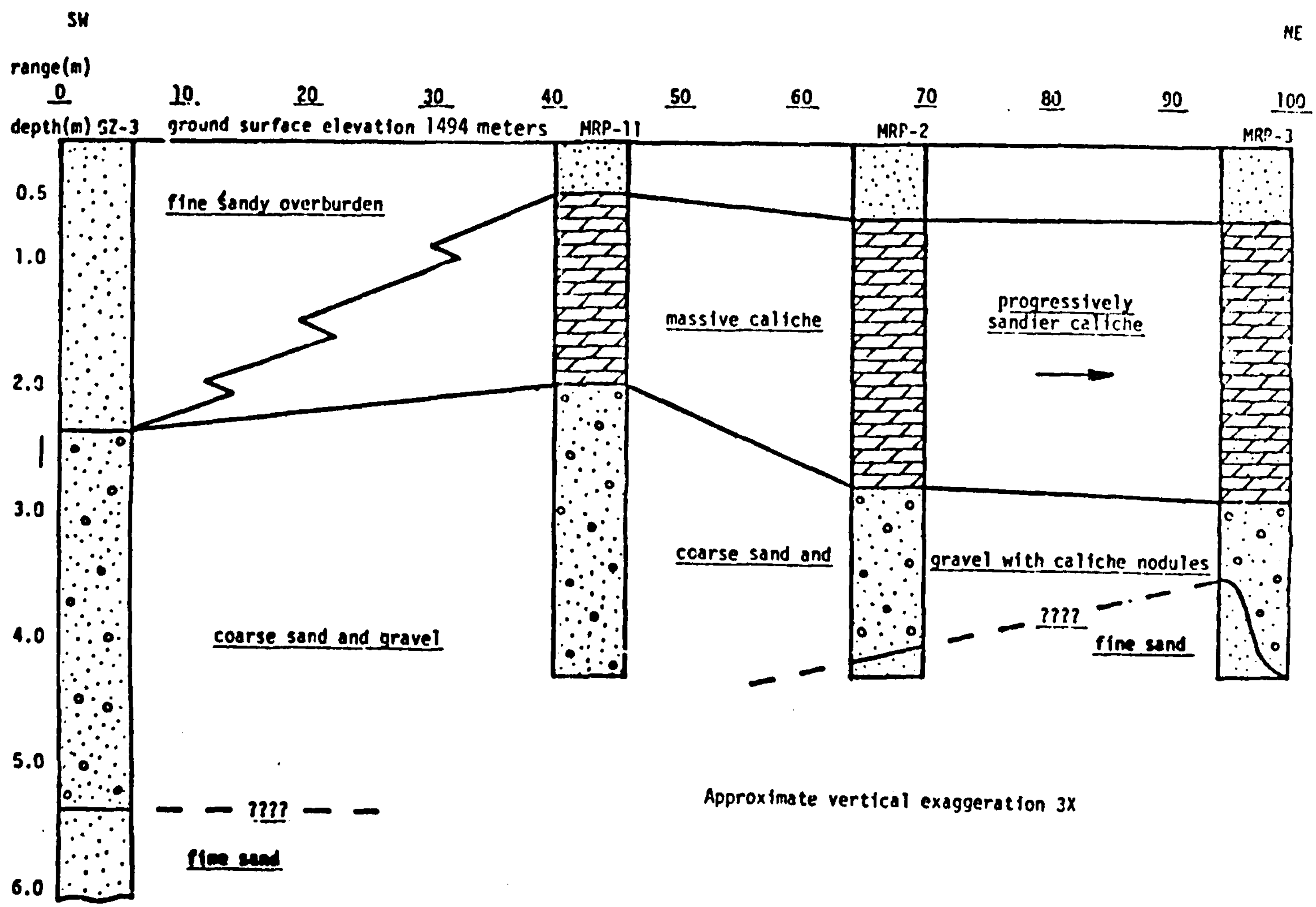
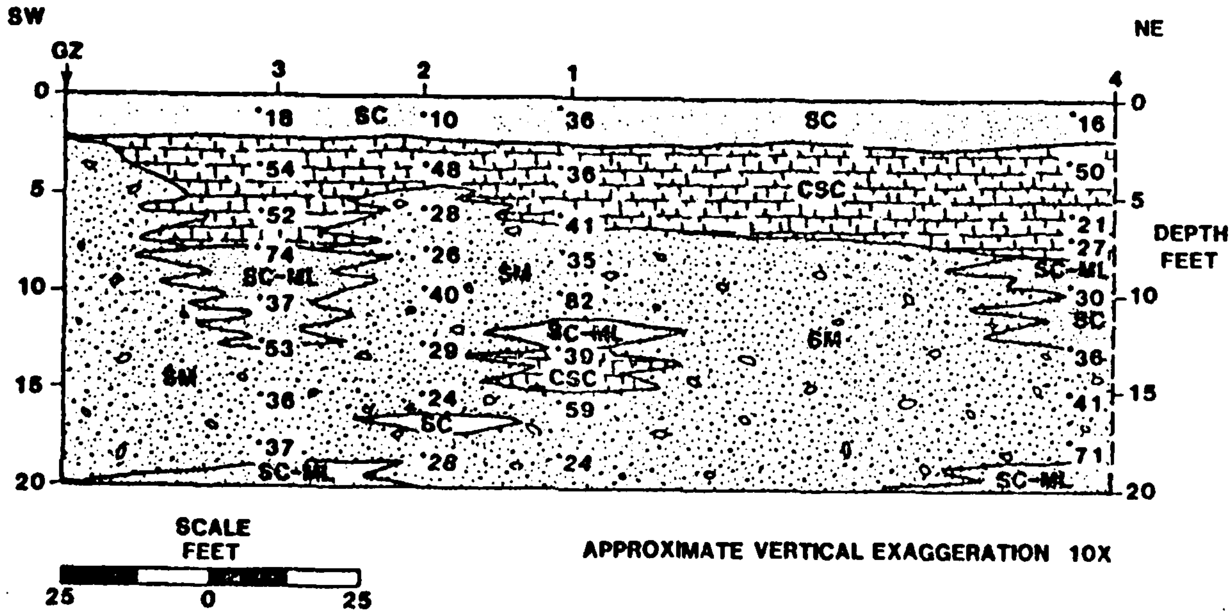


Figure 4. Geologic cross section from GZ-3 to 100 meter range along grid radial 015.



LEGEND

SC — FINE-GRAINED SAND TO SILT

SM — COARSE SAND AND GRAVEL VERY LOOSE, PEBBLES & COBBLES

CSC — CEMENTED FINE-GRAINED SAND TO SILT CALICHE STAGES II - III

SC-ML — FINE-GRAINED SAND TO SILT WITH SOME CLAY

• BLOWS PER FOOT AT SAMPLE POINT

Figure 5. Diagrammatic cross section along MILL RACE grid radial 045.

All boreholes encountered caliche at approximately 2 to 3 feet below the surface except borehole GZ-3. The thickness of this caliche unit varied from 2.5 feet in borehole 2 to 6 feet thick in borehole 3. Observations of cable trenches dug to a depth of 4 feet in the Mill Race testbed also indicate the highly variable thickness of caliche deposits laterally in other quadrants of the testbed. In boreholes 1 and 4 the caliche (4 feet and 6 feet thick, respectively) appeared as a fine white powder which may have totally replaced the soil.

Underlying the caliche unit in boreholes 1 and 2 at 5-feet and 3-feet deep, respectively, is a loose sand and gravel deposit subject to caving while drilling. However, in boreholes 3 and 4, a fine grained silty-sand unit (7 feet deep in both boreholes) underlies the caliche before a loose sand and gravel is encountered at approximately 13-feet deep.

Boreholes 1, 2, and 3 (6 in diameter) were used as pilot holes for the NMERI structure cavities (36 in diameter). The pilot holes were filled with water to facilitate cuttings removal and aid cavity wall stability. The 36 inch diameter cavities drilled by this procedure had minor caving, although the cavity walls maintained their integrity until the structures were placed.

TRENCH AND BOREHOLE SUMMARY

It is difficult to compare boreholes inside and outside the testbed due to the large sampling intervals for boreholes outside the testbed. However, the general pattern of a near surface caliche horizon, of variable thickness and character, underlain by alternating layers of sand and gravel seems to be present at each site tested.

The 15 deg and 45 deg radials have very similar near surface (0 to 15 feet) geologies. Both radials contain a loose sand and gravel layer at depth (approximately 7 feet deep). This layer may cause problems, e.g., caving, for gage and structure placement.

MATERIAL PROPERTIES

Insitu density and moisture contents were measured in the exploration trenches. In addition, samples were taken from the trenches for laboratory analysis of density, moisture content, specific gravity, grain size distribution, and unconfined compressive strength. Table 2 presents both the material property data from the insitu measurements and the laboratory tests.

Bulk densities measured insitu for the surface (0 to 3 feet) averaged 1.53 $g/cm^3 \pm .04\ g/cm^3$. The moisture content measured in the laboratory for this same depth interval averaged 16.7 percent ± 10.5 percent. The moisture content measured insitu was slightly higher averaging 19.2 percent ± 10.5 percent. The difference between insitu and laboratory values may be due to chemically bound hydrogen in the soil, e.g., gypsum $CaSO_4 \cdot 2H_2O$.

The unconfined compressive strength measured on two samples of caliche from trenches MRP-1 and MRP-3 at 2 feet depth was 63 psi and 49 psi respectively.

Bulk densities measured insitu for the 7 to 13 foot depth interval averaged 1.6 $g/cm^3 \pm .04\ g/cm^3$. The moisture content measured in the laboratory for the 7 to 13 foot depth interval averaged 6 percent ±% 4 percent. The moisture content measured insitu was again higher than the laboratory value averaging 13 percent ± 3 percent and may also be due to chemically bound hydrogen. The insitu dry densities for the two depth intervals were not corrected for moisture content (Table 2).

There were no laboratory testing of samples from the boreholes. However, shear strength tests and standard penetration tests were performed in the field (see Appendix A and B).

SEISMIC REFRACTION SURVEYS FOR MILL RACE EVENT

The Air Force Weapons Laboratory (AFWL) participated in the site selection for the Mill Race event by conducting a seismic refraction survey of the areas, Figure 6. The results of the survey are not contained in this report but may be obtained by contacting the AFWL.

Table 2. Material property data base for exploration pits MRP1-3.

Pit	Depth (m)	IN SITU WET Density (PCF)	IN SITU WET Density (g/cm³)	IN SITU DRY Density (PCF)	IN SITU DRY Density (g/cm³)	IN SITU % Moisture	LABORATORY DRY Density (PCF)	LABORATORY DRY Density (g/cm³)	LABORATORY % Moisture	LABORATORY SPECIFIC Gravity	UNCONFINED COMPRESSIVE STRENGTH (MPa)	UNCONFINED COMPRESSIVE STRENGTH (PSI)	Lithology
MRP-1	0.5	93.0	1.49	68.3	1.09	36.1	71.7	1.15	33.7	3.46	0.48	63	Caliche
	1.0	96.4	1.54	78.0	1.25	23.6	80.9	1.29	22.5	3.11			Caliche
	2.0								1.0	2.68			Sand and Gravel
	2.6	96.7	1.55	89.1	1.43	8.5							Sand and Gravel
	4.0	99.8	1.60	89.7	1.44	11.3							Sand and Gravel
MPR-2	0.5	92.4	1.48	85.3	1.36	8.3	79.3	1.27	10.8				Caliche
	1.0	98.7	1.58	83.4	1.33	18.4	93.5	1.50	10.7	2.94			Caliche
	2.0	103.1	1.65	92.4	1.48	11.5	98.9	1.58	8.4	2.83			Caliche
	4.0	100.0	1.60	87.0	1.39	14.9			4.3				Sand and Gravel
MRP-3	0.5	94.9	1.52	87.9	1.41	7.9			10.2	3.10	0.34	49	Sandy Caliche
	1.0	96.3	1.54	79.7	1.28	20.9	93.8	1.50	10.7	2.94			Sandy Caliche
	2.0	97.4	1.56	84.8	1.36	14.8	94.4	1.51	10.4				Sandy Caliche
	4.0	102.5	1.64	89.4	1.43	14.7		8.3					Fine Sand

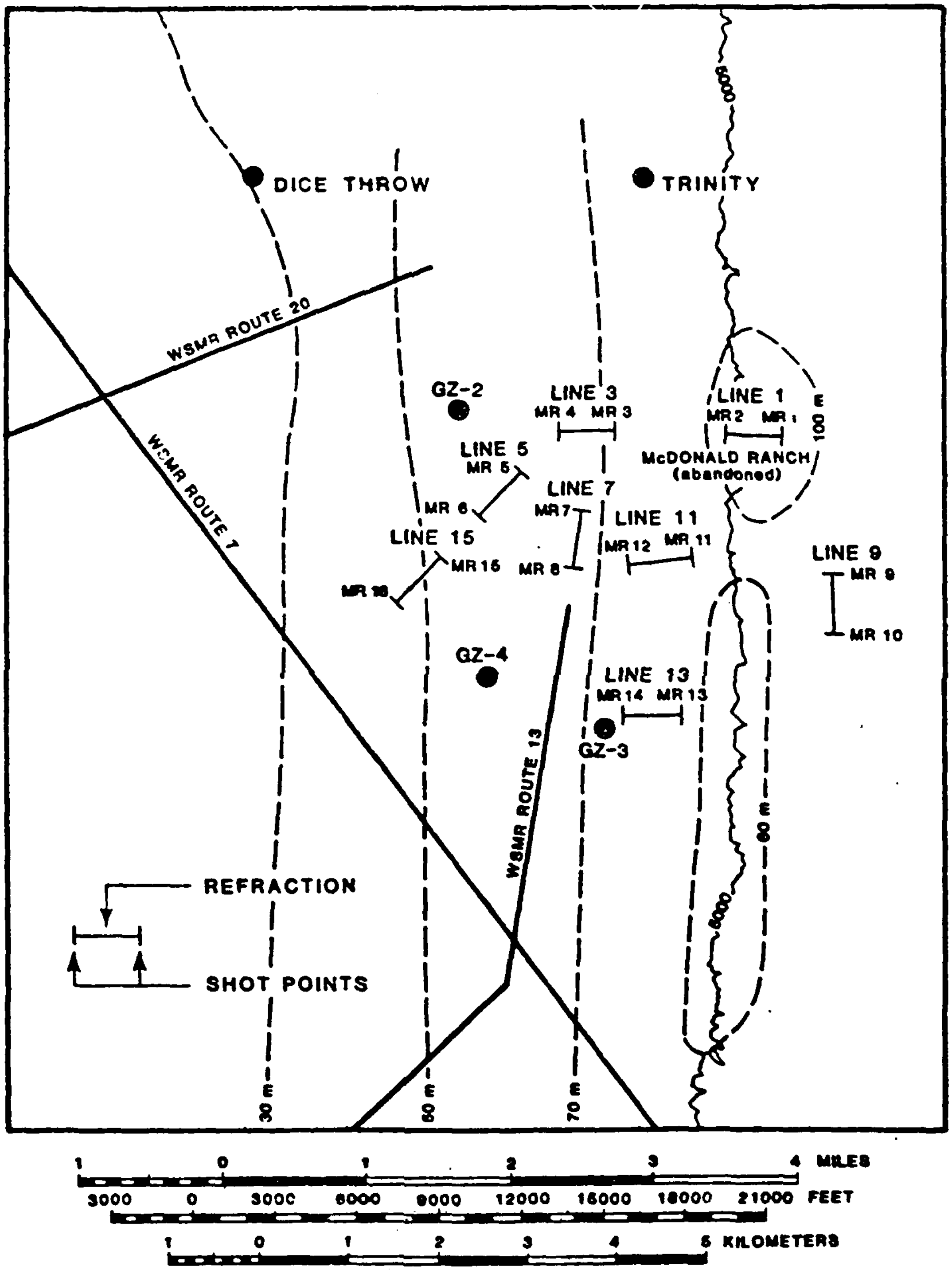


Figure 6. Location of seismic refraction survey for MILL RACE event.

CONCLUSIONS

The following conclusions can be made about the soils at the Mill Race testbed.

1. In general, alternating layers of silty-sand and gravel with depth are found in the Mill Race area.
2. The wet density of soil from 0 to 3 feet deep averaged 1.53 g/cm^3 ± .04 g/cm^3
3. Soil at 7 to 12 feet deep has an average wet density of 1.6 g/cm^3 ± .04 g/cm^3
4. The thickness of near surface caliche deposits varied from 0 to 9 feet thick laterally.
5. Massive caliche at 2 feet depth, (MRP-1) has an unconfined compressive strength (UCS) of 63 psi while sandy caliche at the same depth, (MRP-3) has a UCS of 49 psi.

APPENDIX A

DRILLING LOGS AND LABORATORY RESULTS FOR MILL RACE TEST BED ALONG GRID RADIALS 015° AND 045°

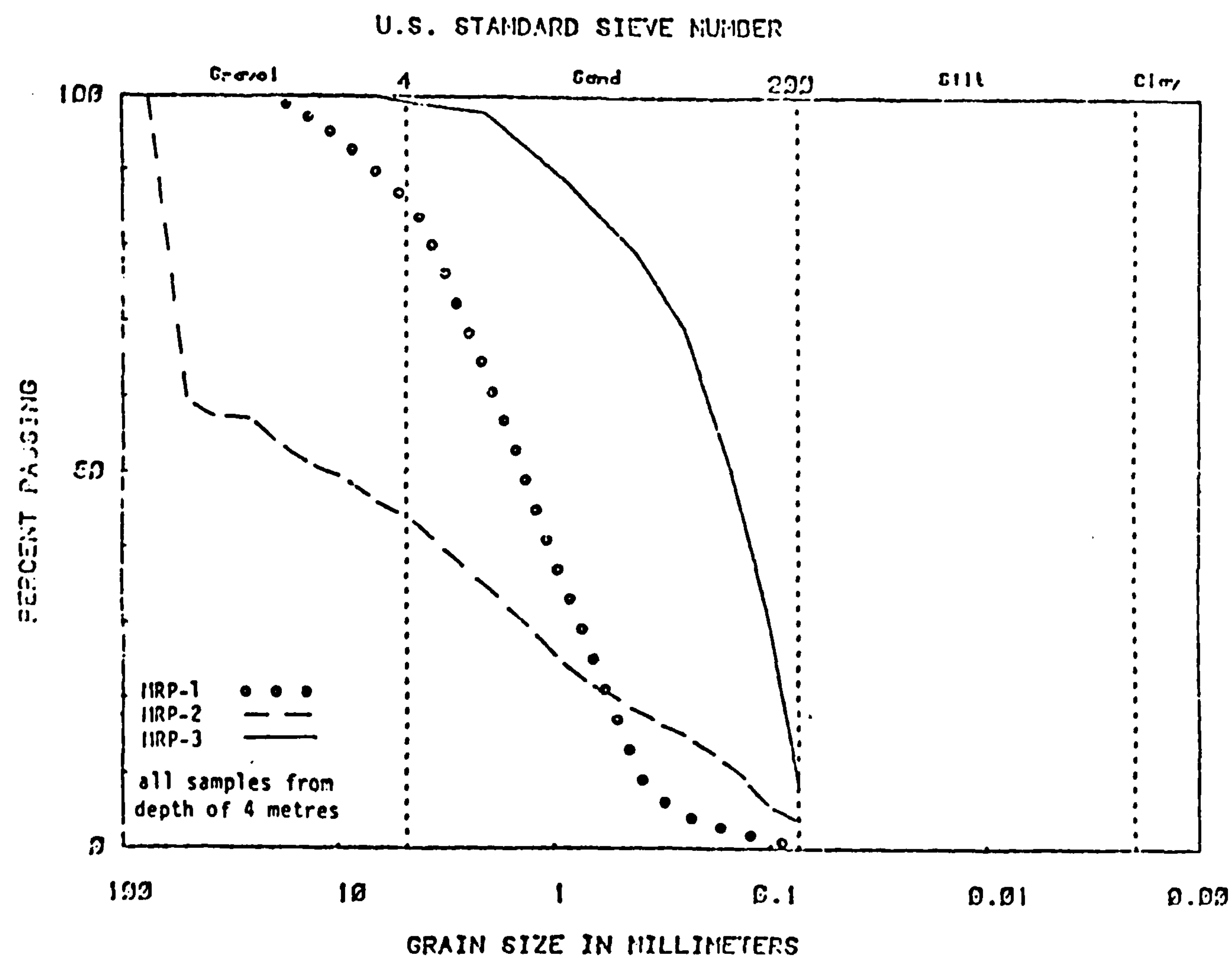


Figure 7. Grain size distribution of coarse sand and gravel.

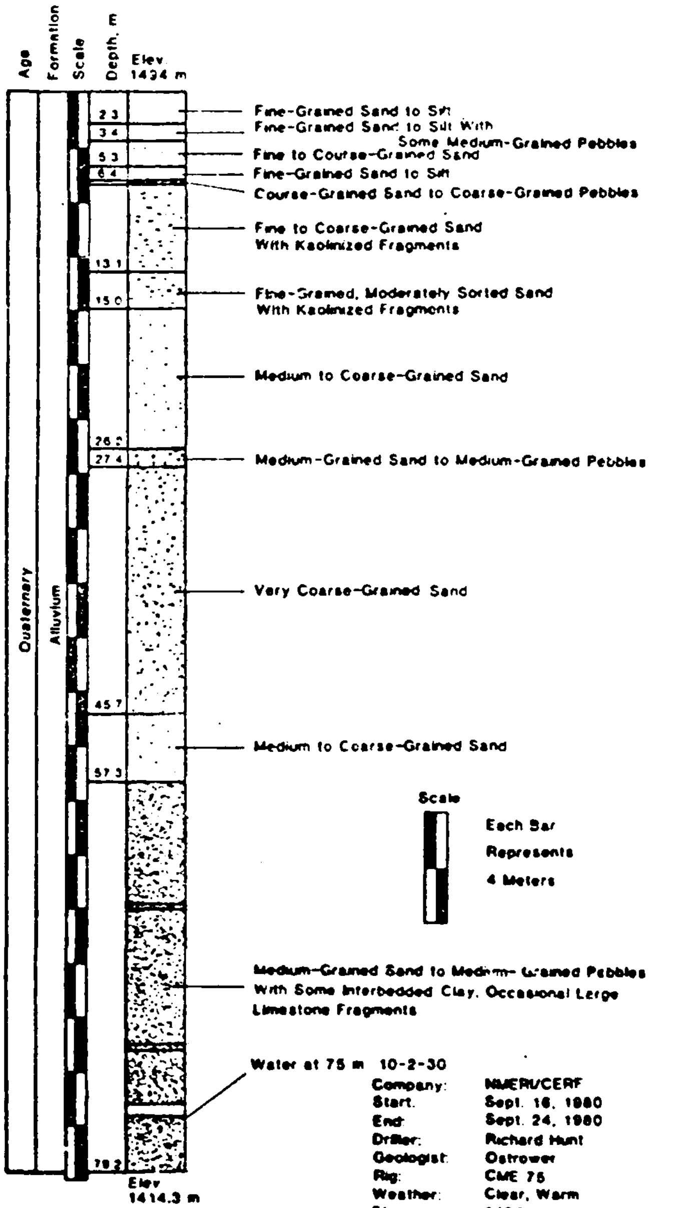


Figure 8. Drilling log MILL RACE GZ - 3
NE 1/4, SE 1/4, SEC 13, 17, 17S, R4E.

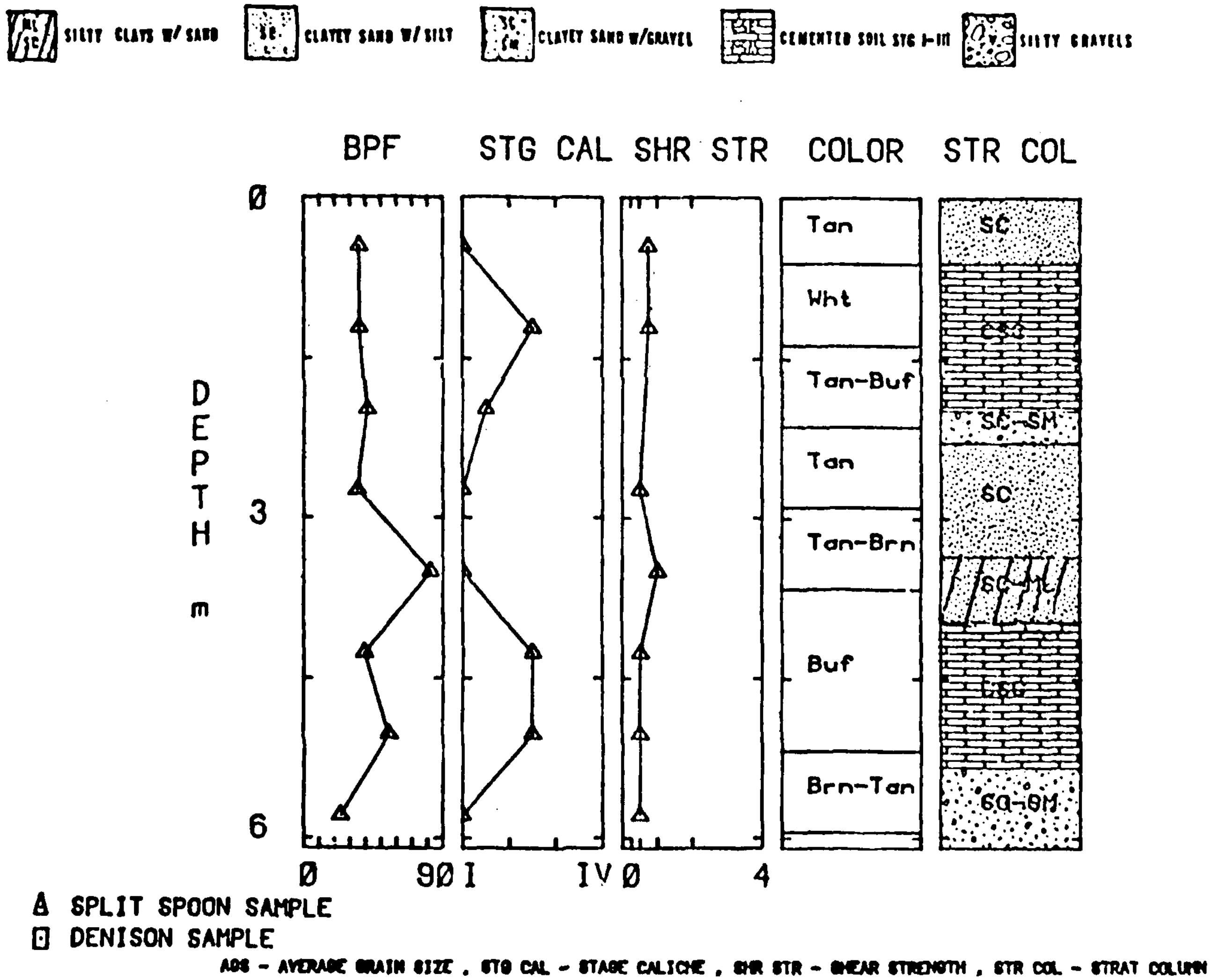


Figure 9. Summary for Hole #1.

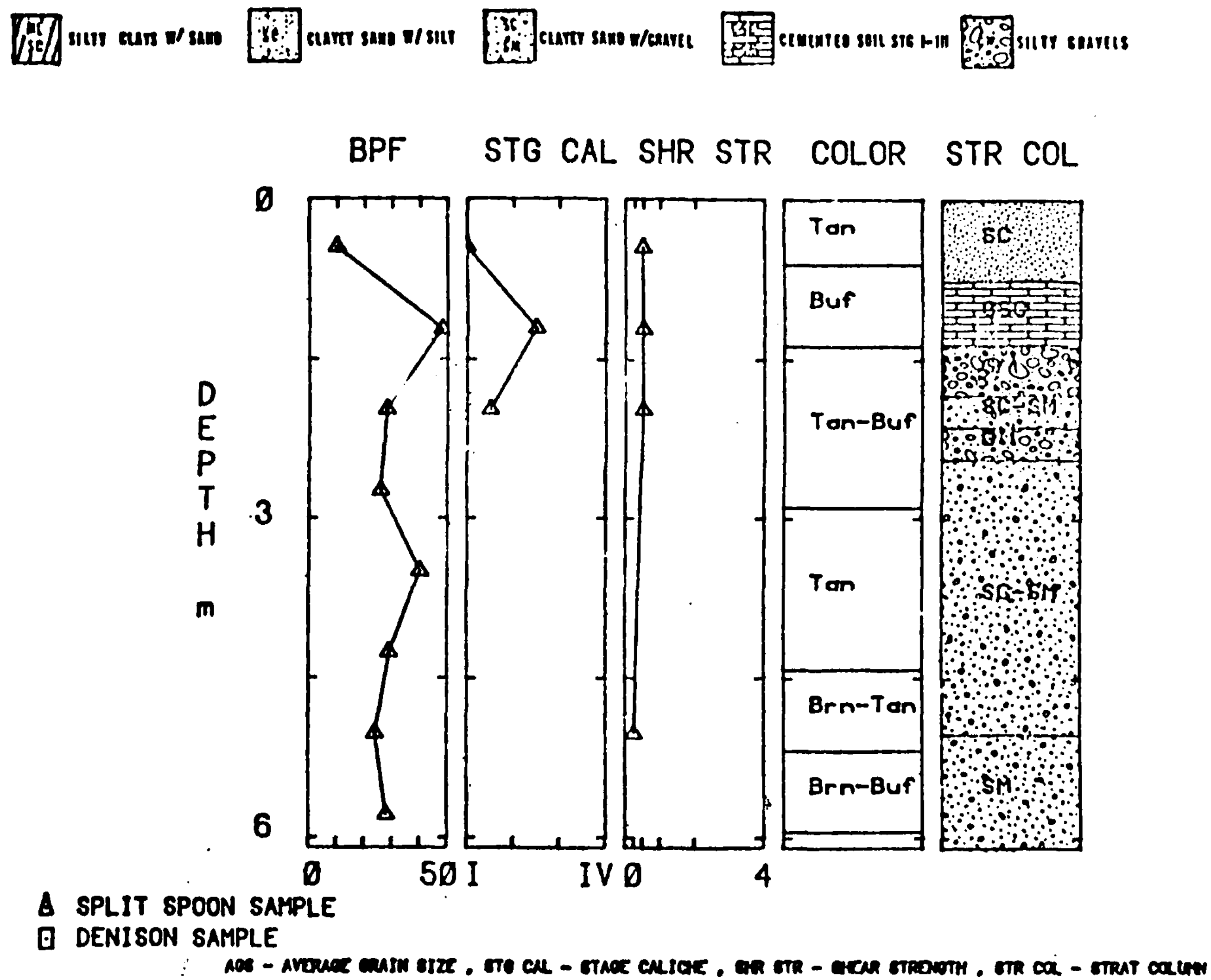


Figure 10. Summary for Hole #2.

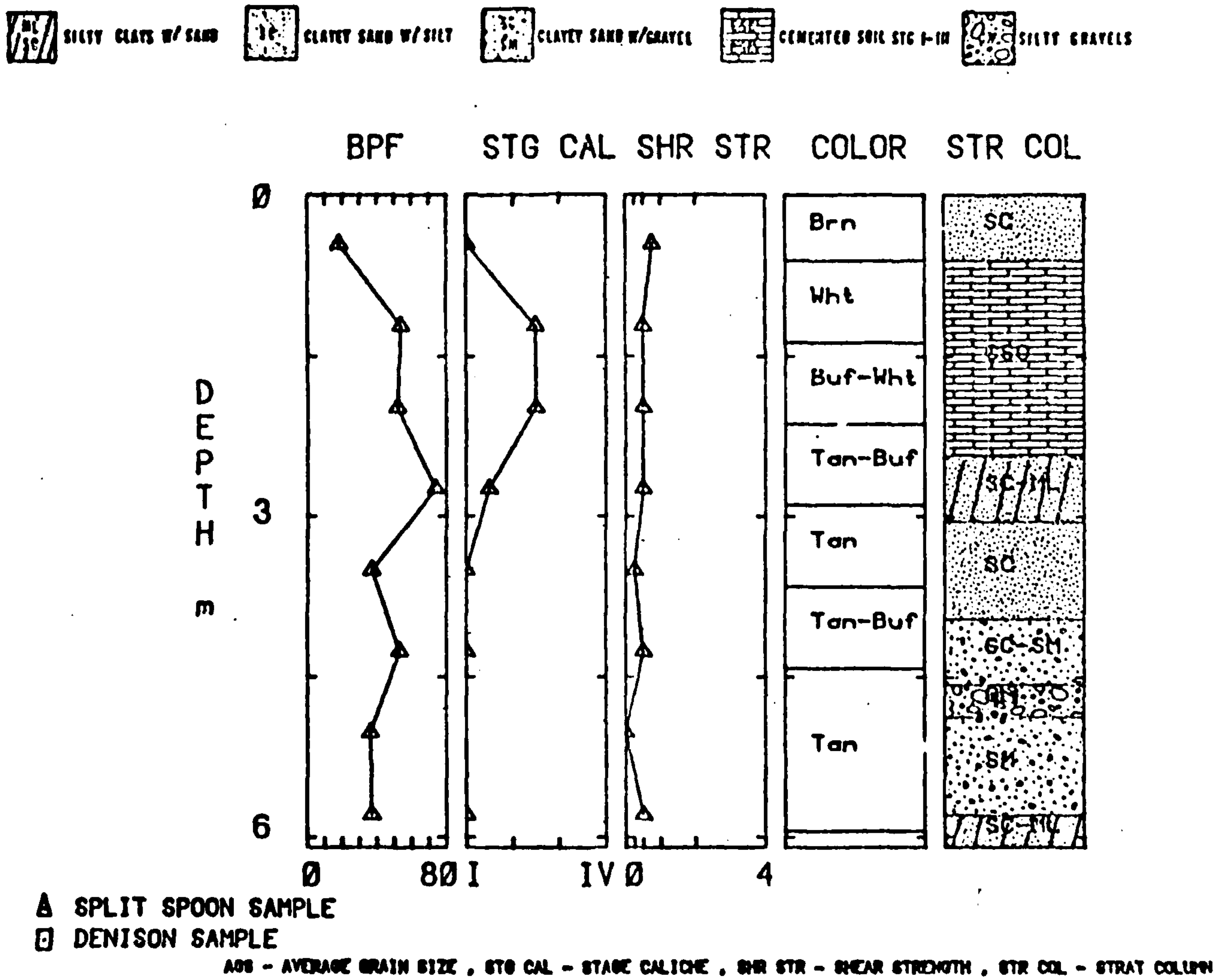


Figure 11. Summary for Hole #3.

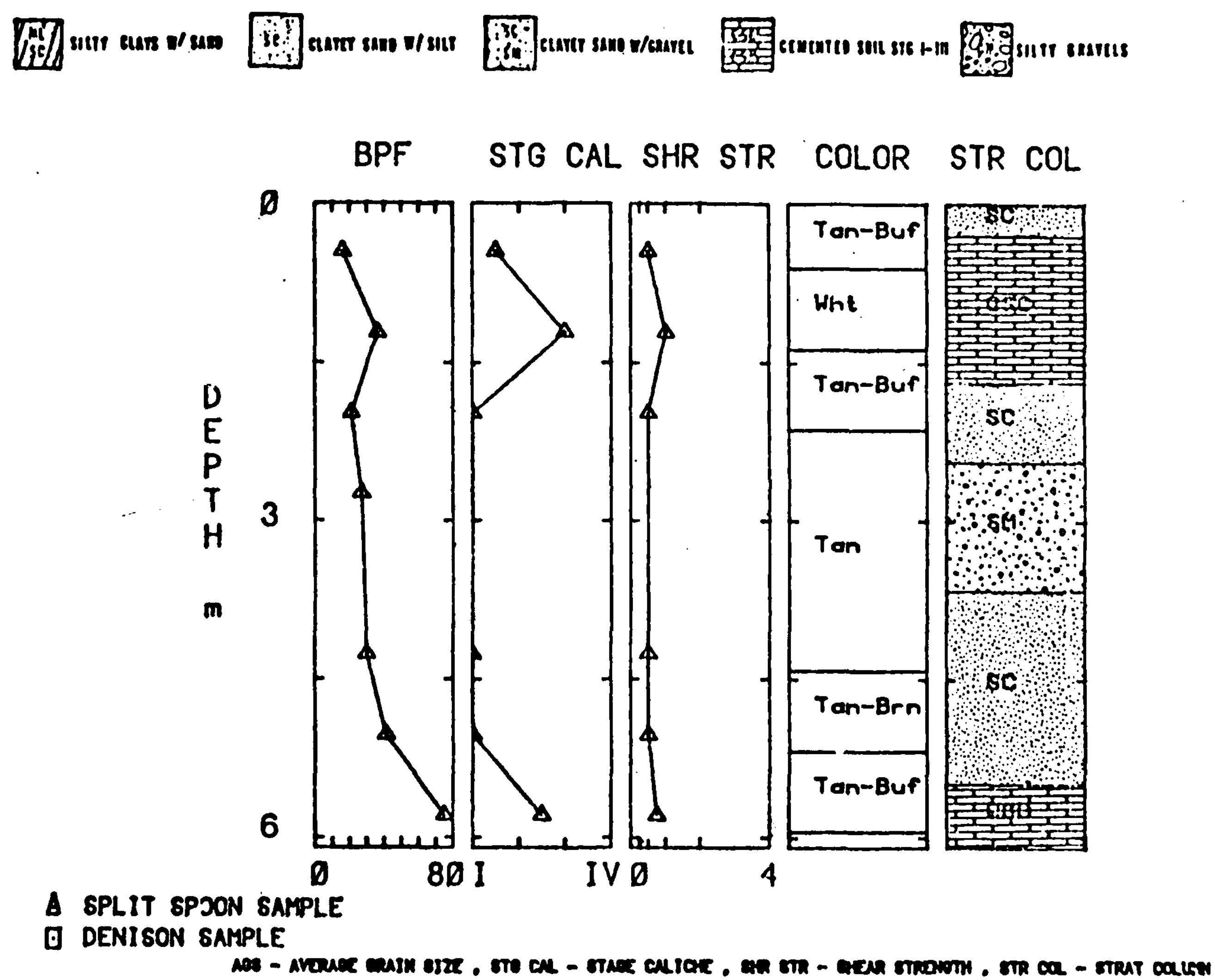


Figure 12. Summary for Hole #4.

APPENDIX B

DRILLING LOGS LOCATED NEAR MILL RACE

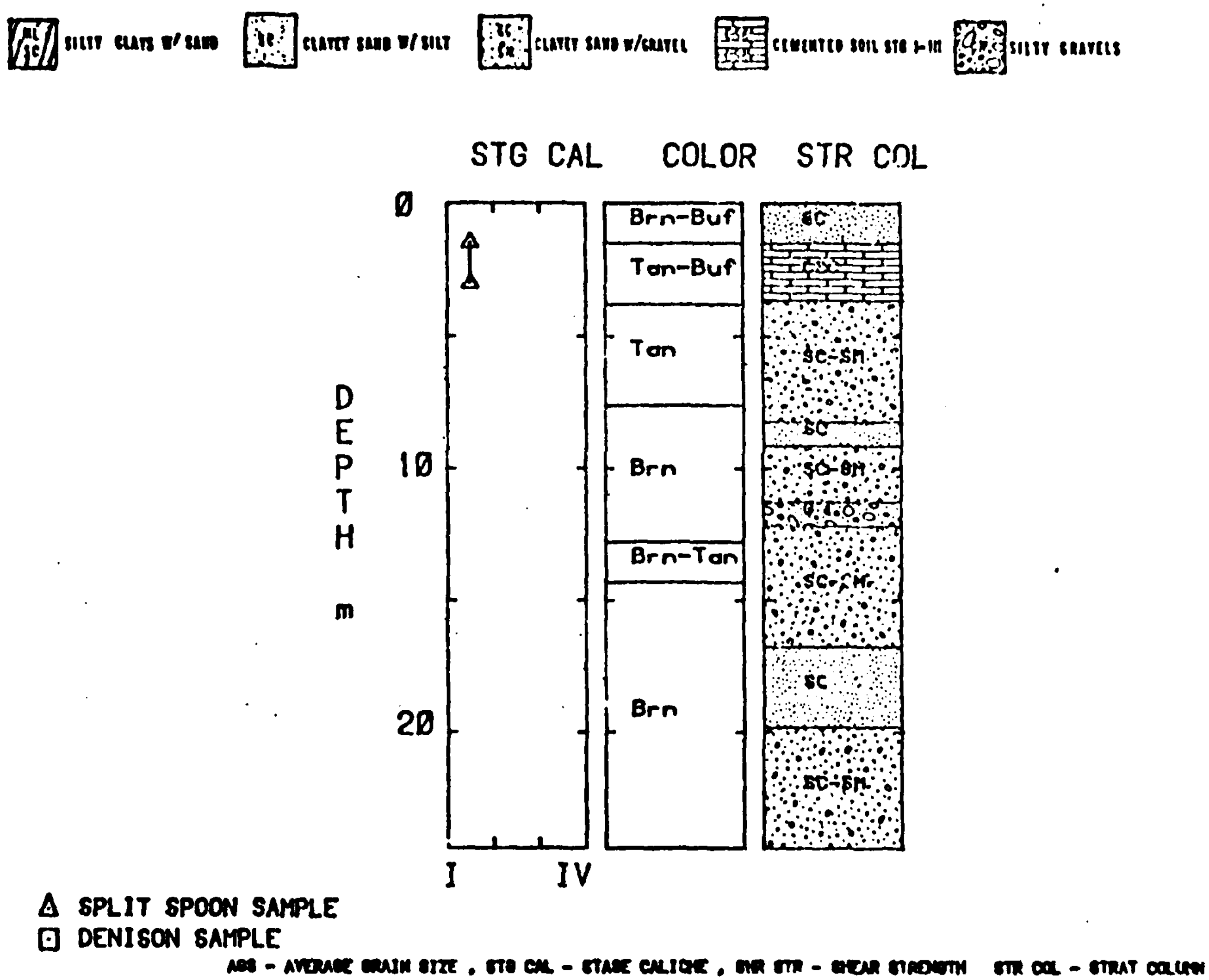


Figure 13. Summary for Hole #1GH.

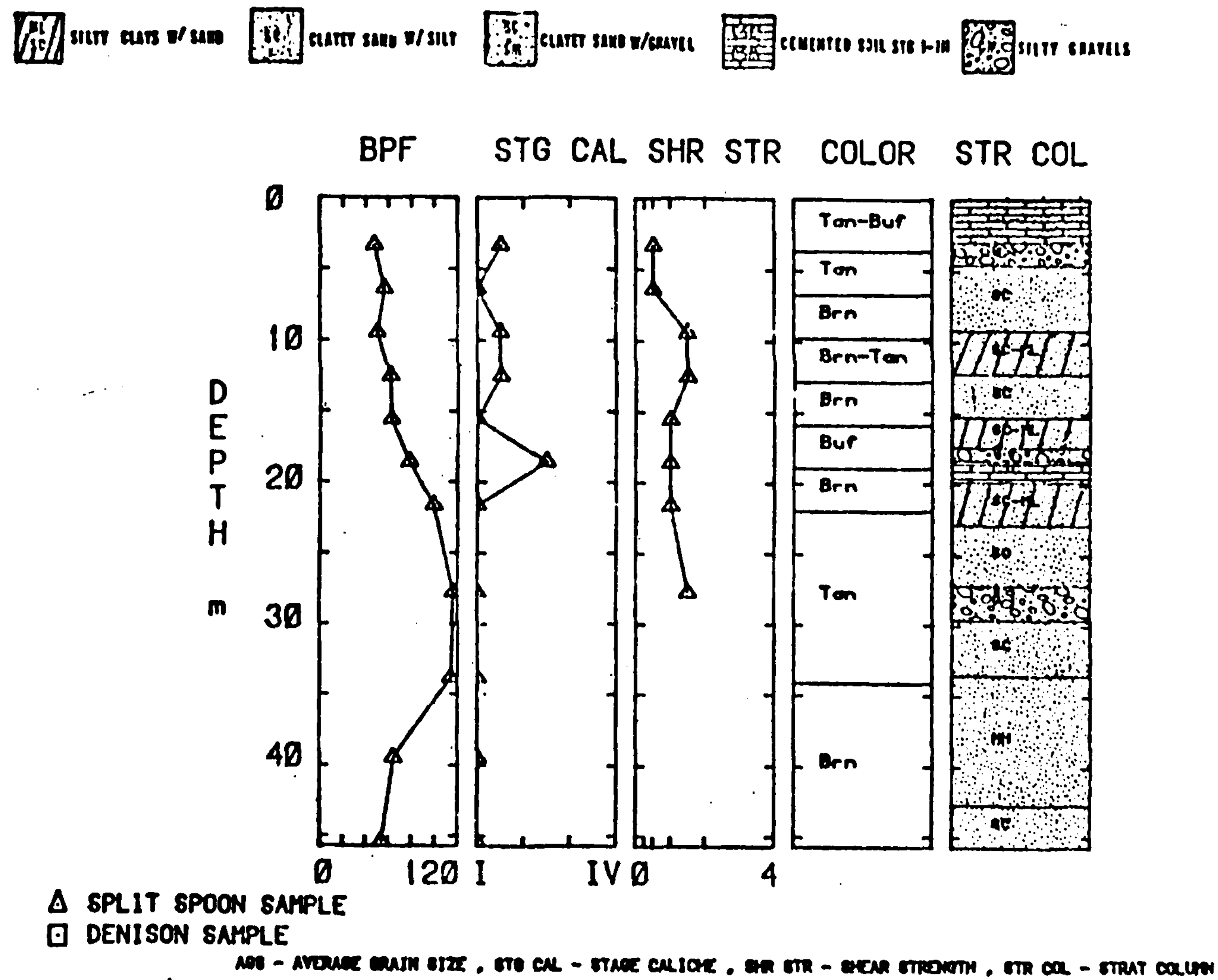
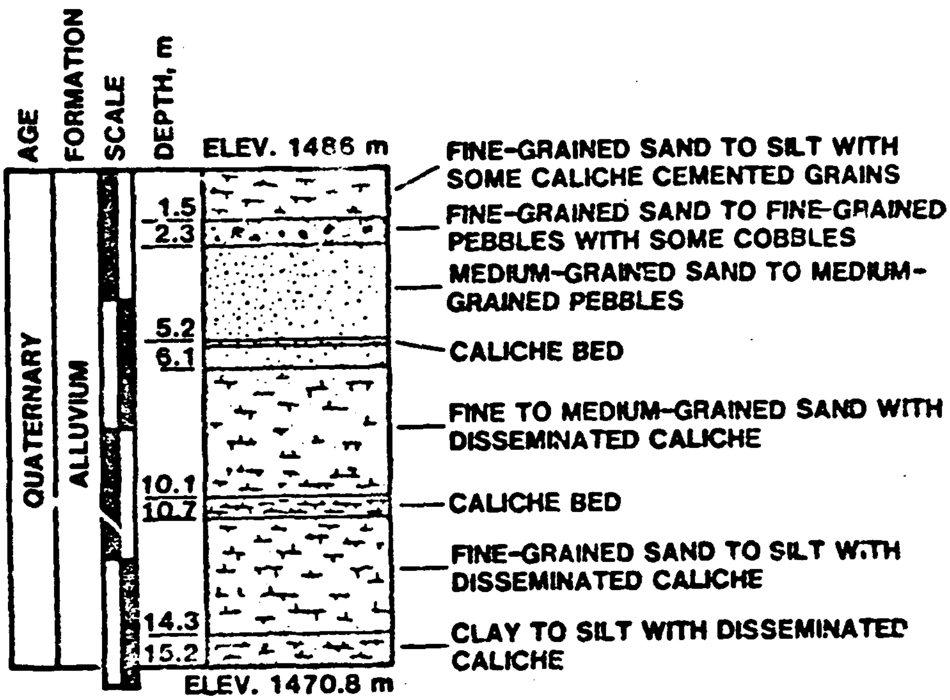


Figure 14. Summary for Hole #2GH.

DRILLING LOG MILL RACE GZ-4
SW 1/4, SE 1/4, SEC. 11, T7S, R4E



SCALE

EACH BAR REPRESENTS 4 METERS

COMPANY:	NMERI/CERF
START:	SEPT. 25, 1980
END:	SEPT. 26, 1980
DRILLER:	RICHARD HUNT
GEOLOGIST:	OSTROWER
RIG:	CME 75
WEATHER:	CLOUDY, WINDY
ELEVATION:	1486 m
TOTAL DEPTH:	15.2 m

Figure 15. Lithologic log for borehole MRGZ-4.

APPENDIX H

ANFO CHARGE QUALITY CONTROL

APPENDIX H

Explosive Material Quality Control for MILL RACE

By

Michael M. Swisdak, Jr.
Explosion Dynamics Branch
Naval Surface Weapons Center

INTRODUCTION

The MILL RACE charge was designed to contain 600 tons of ammonium nitrate/fuel oil (ANFO) -- an equivalent of 500 tons of TNT or 1 kiloton nuclear. The ANFO was supplied by two contractors: Woodard Explosives, Estancia, New Mexico, and Madshaw Explosives, Inc., Hobbs, New Mexico. The contractors jointly purchased bulk ammonium nitrate prill from Phillips Petroleum. The ANFO was supplied in 4-ply kraft paper bags with a nominal weight of approximately 50 pounds.

The Naval Surface Weapons Center (NSWC) was tasked by the Field Command, Defense Nuclear Agency, to provide the following functions:

(1) Design the charge and consult on construction details.
(2) Monitor ANFO fuel oil content.
(3) Monitor bag weight and total charge weight.
(4) Monitor ANFO particle size distribution.
(5) Supply booster system for charge.
(6) Pre-arm charge.

Items (1) through (4) constitute the quality control monitoring performed for MILL RACE and are the subject of this report.

Sampling

Samples were taken from each layer of the charge and analyzed for fuel oil content. Four samples were taken from the bulk ANFO placed on each layer. Each sample was analyzed separately for fuel and content and the results averaged for each layer. The remains of each sample were then combined to perform the particle size analysis.

During charge construction, approximately every tenth bag was pulled from the conveyor, weighed, and returned.

Fuel Oil Content and Bag Weight

The layer-to-layer variations in the fuel oil content can be seen in Tables 1 and 2. These tables also present other information relevant to each layer -- namely: (1) the layer radius, (2) the number of whole bags, (3) the number of bags of bulk, (4) the total number of bags, (5) the average bag weight, (6) the weight of each layer, and (7) the fuel oil content.

[redacted]

D N A
(b)(3)

The average bag weight observed during charge construction was 48.9 ± 1.2 pounds; this compares with a 50.4 ± 1.0 pound bag weight obtained on DICE THROW. Because of the lower average bag weight, more bags were required to obtain a charge weight of 600 tons. The charge design was based on a bag containing 50.0 pounds of ANFO with 0.5 pounds of paper (50.5 pounds total weight). Both ANFO suppliers supplied bags whose average weight was 48.9 pounds (Woodard: 48.9 ± 1.1 pounds and Ladshaw: 48.9 ± 1.2 pounds).

Particle Size Analysis

Both ANFO suppliers were using prill drawn from the same lot. This was evident in a comparison of the average particle size distributions of the material supplied by each. This is shown in Table 3; in this table there is no significant difference between the two distributions for the MILL RACE charge. Table 4 presents the average particle size distribution for the MILL RACE charge. This same information is plotted in Figure 1. For comparison, the DICE THROW particle size distribution is also plotted in Figure 1.

Pages 570-576 deleted

APPENDIX I

EVENT COUNTDOWN

COUNTDOWN

MILL RACE

White Sands Missile Range

OPERATION Event

DATE 14 Sep 81 O-TIME 1000 Hrs.

PAGE 1 OF 11

Weather Forecast 678-1032/2605
Range Operations 678-3706/3925

T-TIME (MIN)	DIRECTED BY	ACTION BY	OPERATION	CHECK	INITIAL
			(All times local on 16 Sep 81)		
-07H 00M		WSMR(NR-CR)	WSMR Starts master countdown (MCD).	1. 0300	
		TRS	Start LOX fill of modules.	2. 0430	
-06H 30M		WSMR(NR-CR) TGD	Establish communication with Range Control on Range Control Net.	3. 0335	
-06H 15M	PD	Road Guards	Report to A-1 to get radios, clip boards and access lists.	4. 0335	
-06H 00M		WSMR(ASL)	WSMR report launch of Meteorology Balloon. Phone J. Reed at 679-4349	5. 0410	
		PD	PD report that internal road blocks are set to control personnel on testbed.	6. 0415	
-05H 00M		WSMR OPTICS	Start camera checks.	7. ✓	
	TGD	NO	Commerce local countdown broadcasts at one hour intervals over radio net.	8. 0500	
		NO	Establish communications with all sites and trailers. If manning after T-5HR, report to test control when manned.	9.	

North Park

WES GM ( ) 0630
BRL ( ) 0330
DNA/SAI ( ) 0740
AFWL ( ) 0500

South Park

TRS/SSI ( ) 0330
NAVY/SRI/SSS ( ) 0330
FEMA/SRI ( ) 0430
BRL So ( ) 0330

T&F ( ) 0400
WSMR ( ) 0330
WES St ( ) 0330
SNLA ( ) 0500

Other

SSI/FEMA ( ) 0500
TRW ( ) 0600
CERF ( ) 0600

COUNTDOWN

MILL RACE

White Sands Missile Range

OPERATION Event

DATE 14 Sep 81 O-TIME 1000 Hrs.

PAGE 2 OF 11

Weather Forecast 678-1032/2605
Range Operations 678-3706/3925

T-TIME (MIN)	DIRECTED BY	ACTION BY	OPERATION	CHECK	INITIAL
			Other (continued)		
			TBE ( ) 0530 UK2 ( ) 0400 TIC ( ) 0800 WSMR Photo ( ) 0230 UK1 ( ) 0530 LANL ( ) 0700 AFTAC ( ) 0730 SNL Photo ( ) 0600		
-04H 30M		IE	Start signal dry runs, check all technical cameras.	10. 0400	
-04H 00M		NO	Mark 4 Hours.	11. 0608	
-03H 00M		NO	Mark 3 Hours.	12. 0708	
	TGD	NO	Make test go ahead decision based on weather conditions. Report test status to range control (NR-CR). Announce status to testbed. Call WSMR PAO 678-3700, FCDNA; SAC, A-7, Aerospace.	13. 0708	
		IE	T&F report readiness to TGD.	14. 0652	
		WSMR (NR)	WSMR send drone initiate signal to T&F.	15. 0630	
		WSMR (ASL)	WSMR report launch of meteorology balloon. Phone J. Reed at 679-4349.	16. ✓	
		EXP. (BRL, WES, WSMR, NAVSEA, UK1	Complete fueling of generators. BRL (✓), WES (✓), WSMR (✓), NAVSEA (✓), UK1 (✓)	17. 0700	
		WSMR(NR-D)	Report to TGD readiness of instrumentation cameras.	18. 0725	
		TRS, TGE	Complete filling TRS with LOX.	19. 0649	
		TGE	Commence removal of secondary lightening protection.	20. 0650	
		IE	Issue 30 minute warning for completion of signal dry runs.	21. 0708	
-02H 45M		TGD	Drone Hold (Approx 10 min.)	22. 0717	

CCUNTDOWN

MILL RACE

White Sands Missile Range

OPERATION Event
DATE 14 Sep 81 O-TIME 1000 Hrs.
PAGE 3 OF 11

Weather Forecast 678-1032/2605
Range Operations 678-3706/3925

T-TIME (MIN)	DIRECTED BY	ACTION BY	OPERATION	CHECK	INITIAL	
-02H 30M		NO	Phone status to SAC HQ (271-5307 A/V Lt Col Tahfes (271-6027 A/V Maj Germerrad	23. 0717		
		WSMR OPTICS	Complete camera checks.	0725		
		IE	Complete signal dry runs.	25. 0739		
		[illegible]	Commence clearing the testbed by experimenters. Experimenters will check out through internal roadblocks.	26. 0739		
		TGE	TGE report removal of secondary lightening protection.	27. 0755		
		TGD	TGD advise WSMR arming charge over Range Net.	28. 0739		
		SNL	SNL report to TGD that firing circuit is safe.	29. 0739		
-02H 20M		SNL, TGE	Arming party enter testbed and start alignment of BIS. Crane support required.	30. 0749		
		SAI	Complete installation of end covers on TRS pits.	31. 0757		
-02H 10M		PD	Road guards report when experimenter personnel clear of testbed.	32. 0850		
-02H 00M		NO	Mark 2 Hours.	33. 0758		
		NO	Phone test status to NWEF, (A/V 244-0534/0619) and Learjet (Alamogordo) (-) call Range Control to advise Learjet over UHF.	34. 0800	1145	
-01H 30M		WSMR (NR-(CR)	WSMR verifies Rt. 7 roadblocks set over Range Net.	35. ✓		
-01H 45M	PD	PD	Experimenter Bus depart Admin Park for observation point.	36. 0820		
-01H 20M		NO	Establish communication with Cessna N4671A on Test Control Net.	37. ✓		

COUNTDOWN

MILL RACE

White Sands Missile Range

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T-TIME (MIN)	DIRECTED BY	ACTION BY	OPERATION	CHECK	INITIAL
-01H 15M		WSMR (NR-CR)	WSMR verifies radar avoidance over Range Net.	38. 0842	
		SNL	SNL reports alignment of BIS.	39. 0830	
		WAI	WAI call by land line to test control. Advise Range Control.	40. 0830	
	TGD	TGD	TGD authorize SNL to arm charge.	41. 0843	1135
-01H 05M		NO	Final experiment readiness check. North Park: WES GM ( ) BRL No ( ) DNA/SAI ( ) AFWL ( ) South Park: TRS/SSI ( ) NAVY/SRI/SSS ( ) FEMA/SRI ( ) BRL So ( ) T&F ( ) WSMR ( ) WES St. ( ) Admin Park: TBE ( ) UK1 ( ) UK2 ( ) LANL ( ) TIC ( ) AFTAC ( ) WSMR Photo ( ) SNL Photo ( ) CERF ( ) TRW ( )	42. 0858	
-01H 00M		NO	Mark 1 Hour.	43. 0858	
		WSMR(ASL	WSMR reports launch of meteorology balloon. Phone J. Reed at 679-4349.	44. ✓	
		NWEF	NWEF confirm take off of A-7 from Stallion Range Controller 679-2271. (Call NWEF at T-55 if no response.)	45. 0916	1137
		TGD	TGD checks communications with Range Controller on range command net. Checks ready hold system.	46. 0912	
		ROAD GUARDS	Report of who is still on Testbed No. ( ) So. ( )	47. 0900	
-55M 00S		No	Commence local countdown broadcasts at 5 minutes intervals.	48. 0908	

COUNTDOWN

MILL RACE

White Sands Missile Range

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T-TIME (MIN)	DIRECTED BY	ACTION BY	OPERATION	CHECK	INITIAL
		PD	OIC Report safety status of OP to TGD.	49. 0910	1143
-50M 00S		NO	Mark 50 minutes	50. 0912	
		WSMR(MET)	WSMR make surface wind report to TGD over telephone.	51. ✓	
		WSMR	Request test status in order to start drones.	52. 0905	
-45M 00S		NO	Mark 45 minutes	53. 0913	
		SNL	SNL report arming complete. Arming party departs GZ and returns to T/F van.	54. 0905	1138
-45M 00S		TGD	TGD report charged armed to Range Controller.	55. 0915	1145
		WSMR(NR-D)	WSMR Lifts Radar avoidance on R-127 and R-128	56. 0915	
-40M COS		NO	Mark 40 minutes	57. 0917	1145
		WSMR	WSMR report drone engine starts.	58. 0917	1115
		IE	North Park and South Park personnel evacuate to Admin Area.	59. ✓	
-35M 00S		NO	Mark 35 minutes.	60. 0934	
	TGD	NO	Order evacuate internal roadblock personnel to Admin Area.	61. 0934	1140
30M 00S		NO	Mark 30 minutes.	62. ✓	
		All Manned	Manned station personnel accountability check.	63. 0930	1200
			MANNED STATION		
			North Park South Park		
			WES GM (✓) TRS/SSI (✓) T&F (✓)		

COUNTDOWN

MILL RACE

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T-TIME (MIN)	DIRECTED BY	ACTION BY	OPERATION	CHECK	INITIAL
			North Park (continued): RBL No (✓), DNA/SAI (✓), AFWL (✓) South Park (continued): NAVY/SRI/SSS (✓), FEMA/SRI (✓), BRL So (✓), WSMR (✓), WES St (✓) Other: Admin O-I-C (✓), OP O-I-C (✓), TIC (✓), LASL (✓)		
		WSMR (NR-CR)	WSMR report Learjc take off from Alamogordo.	64. 0910	1214
		WSMR R.C.	WSMR confirms NWEF A-7 on station.	65. 0925	1214
		Cherokee	Cherokee confirms WAC entering range.	66. 0916	1200
		WSMR R.C.	Commerce countdown over Range Control Net.	67. ✓	
		SNL	SNL confirms arming party arming party arrives at T&F van.	68. 0916	1145
		PD	Verified internal roadblocks personnel in Admin Area, and at OP.	69. 0931	1140
-25M 00S		NO	Mark 25 minutes.	70. 0933	
		TGD	TGD report safety and security clear condition on testbed to Range Controller.	71. 0934	1145
		ARMTE(RUM)	WSMR confirms drone take off over Range Net.	72.	1214
-20M 00S		NO	Mark 20 minutes.	73. 0938	
-15M 00S		NO	Mark 15 minutes.	74. 0943	

COUNTDOWN

MILL RACE

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Weather Forecast 678-1032/2605
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T-TIME (MIN)	DIRECTED BY	ACTION BY	OPERATION	CHECK	INITIAL
		WSMR R.C.	Cherokee confirms WAC in position over testbed.	75. ✓	1217
		WSMR(ASL)	WSMR surface wind report to TGD over telephone.	76. Cancelled	
-14M 00S		WSMR R.C.	WSMR reports Drones A&B join up over Range Net.	77. 1220	
-11M 00S		WSMR R.C.	WSMR reports Drones passing through Mockingbird Gap over Range Net.	78. 1220	
-10M 00S		SNL	SNL request permission from TGD to ready firing panel.	79. 1224	
	TGD	Trailer Operators	TGD direct disable halogen fire protection system in vans.	80. 1223	
-80M 30S		WSMR R.C.	WSMR report drones passing first sync point over Range Net.	81. ✓	
-05M 00S		NO	Commence 1 minute countdowns.	82. 1225	
		SNL	Confirm firing panel is ready.	83. 1225	
		TGD	TGD report to Range Control firing panel ready over Range Net.	84. 1230	
-04M 00S		WSMR R.C.	WSMR confirm Learjet attains working altitude of 14000 MSL over Range Net.	85. ✓	
		WSMR R.C.	Mark T-4 minutes for drones	86. 1230	
-03M 00S		TGD	MILL RACE testbed hold for 1 to 2 minutes for drone synchronization.	87. 1231	
		WSMR(RCC)	DFCS sends 30 second warning for drones to be at T-3 position. Need long countdown.	88. 1233	
		TD	T&F confirm signal received from drones (discrete net)	89. 1233	
-03M 00S		TGD	Resume countdown.	90. 1234	

COUNTDOWN

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T-TIME (MIN)	DIRECTED BY	ACTION BY	OPERATION	CHECK	INITIAL	
-02M 45S		T&F	Start recorders.	91. ✓		
-02M 00S		NWEF	NWEF start pressure transducer air drops (negative report only)	92.		
-00M 60S		NO	Commence 10 second countdown announcements.	93. ✓		
		SNL	Confirm high voltage (negative report only).	94.		
-00M 30S		T&F	TRS sequence initiated (negative report only).	95.		
		NWEF/SNAL	A-7 complete pressure transducer air drop (negative report only).	96.		
-00M 10S		NO	Commence one second countdown announcements.	97. ✓		
-00M 05S		T&F	TRS firing sequence commences (negative report only).	98.		
		NO	Commence radio silence.	99. ✓		
-00M 00S		T&F	Detonate charge.	100. 1236		
+00M 05S		NO	Begin plus count in 1 sec increments.	101. 1236		
+00M 10S		NO	Net Operator resumes plus count at 10 sec intervals.	102. ✓		
+00M 30S	TD	TD	TD orders SNL to safe firing system.	103. 1236		
+01M 00S		TD	TD reports firing system safe to TGD.	104. ✓		
		TGD	Reports firing system safe to Range Control.	105. ✓		
		PD	Re-entry team depart Admin Park to reestablish internal roadblock.	106. ✓		
		NO	Provide plus count broadcasts at one minute intervals.	107. ✓		
		All Trailers	Schedule call in for manned station.	108. 1238		

COUNTDOWN

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T-TIME (MIN)	DIRECTED BY	ACTION BY	OPERATION	CHECK	INITIAL	
			North Park: WES GM (✓), BRL No (✓), DNA/SAI (✓), AFWL (✓); South Park: TRS (✓), NAVY/SRI/SSS (✓), FEMA/SRI (✓), BRL So (✓), T&F (✓), WSMR (✓), WES St (✓); Other: Admin O-I-C (✓), OP O-I-C (✓)			
+02M 00S		WSMR	Learjet vectored over testbed to start cloud track.	109. ✓		
+05M 00S		PD	PD verify internal road blocks set. Reentry party to proceed to testbed and North Park.	110. ✓		
		PD	Commence fire and safety check.	111. ✓		
+05M 00S		NO	5 minute mark.	112. 1241		
	TGD	Trailer Operators	TGD direct reset halogen fire protection system in trailers.	113. 1241		
		NO	Relay shot time to microbarograph operators. (Call Jack Reed at 679-4349)	114. ✓		
		WSMR(ASL)	WSMR launches meteorology balloon launch.	115. ✓		
+10M 00S		NO	10 minute mark.	116. 1246		
		NO	Provide plus count at 10 minute intervals.	117. 1246		
		NO	Advise SAC of event detonation. No call SAC at A/V 271-5307.	118. 1256		
+15M 00S		PD	Fire department report on control of fires.	119. No Fires		
		PD	Safety party reports testbed safe. UK1 (✓) UK2 (✓) BRL (✓) NAVSEA (✓)	120. 1315		

COUNTDOWN

MILL RACE

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T-TIME (MIN)	DIRECTED BY	ACTION BY	OPERATION	CHECK	INITIAL
	PD	PD	WSMR security (✓)1247, SAI (✓)1304, (if possible) (✓)____, and BRL (✓)1306, (when cleared) reentry to exp.	121. 1315	
		TGD	Report testbed is safe to WSMR Range Controller	122. 1250	
+30M 00S		WSMR	Report classified experiments covered.	123. ✓	
		CERF, TGE	Rope off debries collection areas and cra'er area.	124. 1308	
		WSMR (MP)	Lift external roadblocks.	125. ✓	
		ARMTE	WSMR confirms recovery of drones at Northrup.	126. 1300	
		CERF/WSMR (FE)	Install control markers for Aerial Photograph.	127. ✓	
		NO	Call WSMR PAO (678-3700) to advise success of shot	128. 1315	
	PD	FE	Water down route 13 (repeat hourly).	129. 1310	
		WSMR (OPTICS)	Commence removal of film in Diagnostic Bunkers	130. 1310	
+45M 00S		TGE	Complete setting road barriers at 1000 feet from GZ, set visitor control lane.	131. 1319	
+01H 00M		PD	Commence guided tours.	132. 1320	
+01H 00M		NWEF,	Report mission complete. Contact Range Control at Station 679-4430	133. 1303	
		NO	Provide plus count at one hour intervals.	134. ✓	
	TGD	EXP.	Open testbed to all experimenters. Vehicles remain behind road barriers.	135. 1327	
+01H 30M		WSMR R.C.	Release Learjet aircraft to Cherokee	136. 1350	

COUNTDOWN

MILL RACL

White Sands Missile Range

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T-TIME (MIN)	DIRECTED BY	ACTION BY	OPERATION	CHECK	INITIAL
[redacted]		[redacted]	[redacted]	137. 1525	
		PD	Retire internal road guards.	138. 1315	
		WSMR (NR-CR)	Release WAC aircraft to Cherokee.	139. ✓	
+02H 30M		WSMR R.C.	Report Learjet on ground at Alamogordo.	140. ✓	
+04H 00M		WAC	Complete Aerial Photography.	141. 1610	
+05H 00M		NO	Terminate plus count. Close Range Net.	142. ✓	
		SUNDOWN	START PARTY.	XXX	

XXX NO CHECKS ACCEPTED!!!

APPENDIX J

MILL RACE COUNTDOWN HOLD POLICY

APPENDIX J

MILL RACE COUNTDOWN HOLD POLICY

1. Hold window 0900 to 1500 hours.
2. Hold Criteria:
   a. loss of 10 percent of ground instrumentation, i.e., 80 or more data channels
   b. Loss of Drone A
   c. Loss of any TRS
   d. Loss of power to either trailer park
   e. Loss of power to any one trailer with more than 10 percent of ground instrumentation, i.e., 80 or more data channels
   f. Hold for Drone B up to two hours
   g. Hold for photo aircraft up to 24 hours

CAPT FRED JAEGER
CAPTAIN, USAF
TECHNICAL DIRECTOR
MILL RACE

APPENDIX K

LESSONS LEARNED

APPENDIX K

LESSONS LEARNED

1 INTRODUCTION.

This is a compilation of ideas generated and lessons learned by the MILL RACE Test Group Staff during their close association and involvement with the MILL RACE high explosive test. The purpose of this compilation is to provide future Test Group Staffs with information that will help in conducting a successful test. Problems with suggestion solutions, as well as pitfalls to be avoided, are pointed out.

This report is arranged into the general categories with each category, addressing several topics. An attempt has been made to put the topics of each category in a chronological order.

The categories are:

a. Test Group Staff
b. Scheduling/Planning/Project Officers Meetings
c. Technical Support Plan
d. Cables
e. Financial
f. Instrumentation Trailers
g. Experiments
h. Dry Runs
i. Photography
j. Observation Point
k. Miscellaneous

2 TEST GROUP STAFF.

a. Organization.

Once the Test Group Staff (TGS) was organized and began to function as an entity, it became evident that there was not a standard organization for TGSs with all functions, duties, and responsibilities well defined. While each high explosive test is unique and all TGS functions cannot be defined early and precisely, there is commonality for certain functions which should be assigned to specific members of the TGS. The Staff should be adequate in numbers, well trained and yet experienced enough to absorb new members for the training/learning/teaching process. Assuming a test the size and nature of MILL RACE, the TGS should have a Test Group Director, a Technical Director, three Program Directors (one each for Operations, Experiments, and Photography), a Program Analyst, a Test Group Engineer, an Engineering Assistant, an Instrumentation Engineer, and a Cable Coordinator. It is highly recommended that the Test Group Director, Technical Director, Program Analyst, Test Group Engineer, and Instrumentation Engineer have previous testing experience.

For MILL RACE the duties of individual TGS members are found in Appendix B of the MILL RACE Program Document. Without going into any detail it is important to state that the Test Group Director should not get involved with specific duties. Specific tasks should be given to the other members of the staff and the TGD monitor the staff's efforts and performance. The one exception is for the TGD to become involved in dry run countdowns and the countdown to execution. Additional and specific recommended assignments not included in the Program Document follow:

<u>Technical Director</u>

(1) Approve Experiment Data Sheets (EDSs)
(2) Force resolution of add-on experiments
(3) Charge diagnostics

<u>Program Director - Operations</u>

(1) Administrative support
(2) Test site operations
(3) ANFO manufacture and stacking
(4) MBA and BIS
(5) Security
(6) Meteorology
(7) Communications
(8) Aircraft operations
(9) Safety
(10) Housing
(11) Equipment/material control
(12) Vehicles
(13) Far field blast monitoring
(14) BPAs and rental contracts

<u>Program Director - Experiments</u>

(1) Visitors
(2) Observation point
(3) Public Affairs Officer
(4) Experimenter liaison/coordinator
(5) Environmental assessment/archeological survey
(6) Program documentation (Program Document, Test Execution Report, and Symposium Report)
(7) Project Officers Meetings and Symposium
(8) Crater Party

Program Director - Photography

(1) Aerial photography

(2) Technical photography

(3) Still and movie documentary for test and experimenters

(4) Movie

Program Analyst

(1) Maintain tickler system for entire staff

Instrumentation Engineer and Cable Coordinator

(1) Operation of the T&F system

(2) Cable hookups and experimenter support

(3) Cable layout design with Test Group Engineer (TGE)

(4) Power system design with TGE

(5) Lay and recover cable

(6) Cable use data

b. Composition.

While ideally a TGS should be composed of knowledgeable and trained individuals, the contingencies of the Services are such that a staff that has become experienced on one test may not be available for the next test because of reassignments. Using the Long Range Schedule and known rotation/reassignment dates, Test Directorate should make every effort to assign a mix of experienced and non-experienced personnel to each TGS. Once a TGS has been selected and functions assigned, no changes should be made to the staff and all members should be required to accomplish their assigned duties. A change in the staff requires an education of the new member by an old member with subsequent loss of time well needed for other tasks.

c. Technical Director for Subsystems.

Responsibilities for fielding TRS on MILL RACE were fragmented causing considerable confusion, lack of coordination, and wasted effort. This also led to confusion among the experimenters as to whom they should be talking to about their experiments and requirements. In the future and especially with the TRS now that it is out of the development stage, all subsystems should be integrated into the test event with the TGD solely responsible for fielding all subsystems and one TD responsible for technical aspects of the test and all subsystems.

d. Fielding.

At times members of the TGS were embarrassed when they were asked questions for which they had no answers about the experiments, testbed, construction, etc. Test Group Staffs should become more involved earlier with fielding efforts so that each has a better idea of what is happening on the testbed prior to full-time fielding. A suggested solution to this problem is to have all members of the TGS start their part-time fielding TDY earlier than presently scheduled at about the minus sixth month mark. The TGS members could then spend some time with experimenters to become familiar with the experiments, the testbed, and construction requirements.

e. Staff Meetings.

Staff meetings were normally held twice a week; Tuesday afternoons and Friday mornings. The meeting times often interfered with other work in progress. It is recommended that meetings be conducted early in the morning (possibly prior to the normal start hour) at a location where outside interferences are minimized. A frequency of two meetings per week is sufficient and daily meetings are excessive. Staff meetings often lasted too long so it is recommended that staff members be advised to discuss only items of general interest to other staff members.

3 SCHEDULING/PLANNING/PROJECT OFFICERS MEETINGS.

a. Test Scheduling.

MILL RACE, DISTANT RUNNER and for a while MULTIBURST all being fielded at the same time severely taxed the resources of WSMR. The Facilities Engineer and Optics (technical photography) bore the heaviest burdens. Manpower and equipment resources were often not available to do work on schedule resulting in delays or inadequate test preparation. Also WSMR often confused the requirements for the different tests. As an absolute minimum, tests should not be scheduled closer than two months apart at WSMR.

b. Project Officers Meetings.

Test requirements are normally collected at the first Project Officers Meeting (POM) and modifications made at the second POM due to funding constraints. A third POM was not held for MILL RACE and it is recommended that such a POM be held shortly before fielding commences, or at about D-180. The purpose of the third POM would be to review experiment and testbed designs, verify all fielding requirements, and disseminate up-to-date information on fielding.

c. Milestone Scheduling.

Throughout the MILL RACE fielding effort, a number of scheduled events such as delivery of experiments, progress reports, support requirements, dissemination of information and various aspects of shot preparations slipped beyond the date scheduled. Slippage would often require extra work by the TGS. To reduce slippage it is recommended that a very detailed schedule of events should be published and provided to all test participants. To assist in this effort, fielding agencies should submit schedules of when their personnel and experiments are scheduled to arrive on the testbed. These schedules should then be supplemented by periodic progress reports. These schedules/progress reports would then be integrated into the detailed master schedule. The TGD must publicize when and what information is due through official correspondence.

To supplement a master schedule, the Program Analyst must maintain a tickler or suspense file to use in advising the TGS/TGD of required actions. This file should be quite detailed showing the significant steps to accomplish each function. The Program Analyst can then advise the TGD of any slippages.

d. Postshot Planning.

The natural tendency of the TGS was that almost all planning efforts were directed towards the execution of MILL RACE and that very little thought was given to postshot events. The result was that after the big build up to execution, there was inadequate planning of activities for the days immediately following the event.

The TGS must plan for postshot events prior to the event, inform the experimenters of the postshot activities, and stress the importance of those activities. Specifically, experimenters must be advised when environmental data will be available, what reports are due and when, and, most importantly, when the submission of preliminary test results is due. The TGS must plan out postshot recovery activities and advise all concerned, especially experimenters who need assistance in recovering experiments and shipping equipment. The important thing to remember is that there are postshot activities that must be planned and all involved agencies must be informed of those activities.

4 TECHNICAL SUPPORT PLAN.

Methods used on MILL RACE to obtain test support requirements were the Experiment Data Sheets (EDSs), POMs, and personal contacts. With several sources of information input, there were times when requirements conflicted. In addition each staff member coordinated with the individual experimenter at the POMs to acquire specific information needed by that staff member. In the long run, these methods eventually provided the information needed. An improvement to obtaining the needed information would be to implement the use of a Technical Support Plan (TSP) for HE tests. The TSP must be comprehensive by adding sufficient supplementary forms/sections/questionnaires so that experimenters are forced to consider all their requirements. It is strongly recommended that a TSP package be prepared four months prior to first DIRECT COURSE POM.

5 CABLES.

a. Laying of Cable.

The cable coordinator arrived in the field 6 months prior to the MILL RACE execution date ready to lay cable. However, labor support was not available from WSMR FE for another 6 weeks. Even though there will be changes to experiments, additions and deletions, it is recommended that the cable laying not start until minus 4-1/2 months prior to shot day. Extra time for surveying, construction, and planning would then be more cost effective and still allow ample time for cable laying.

b. Trencher Support.

Three trenchers were used--one owned by DNA, one rented for two months before shot, and one furnished by WSMR on a part-time basis. On several occasions none of these trenchers were available because of mechanical malfunctions or because of use on other projects causing minor trenching delays. Most problems could be eliminated by the purchase of a second trencher by DNA with both trenchers dedicated for support of a specific event. This purchase is recommended. A good preventive maintenance program will ensure availability of trenchers. A third trencher may have to be rented during high use periods.

c. Quantity of Cable.

Cable ordered from NTS for use on MILL RACE requested the type of cable and total quantity required. The assumption was made that cable would come in 5,000-foot lengths (unless otherwise stated) and that it would be usable. These assumptions were wrong. For MILL RACE, a 10 percent contingency was added to all cable requirements. Even with a 10 percent contingency ordered, at times the cable received was inadequate due to both damaged cable and inconsistency in cable length. The cable received varied in length from 1,000 feet to 5,000 feet with the shorter cables being unusable due to the testbed layout. It is recommended that cable be ordered by type and specific lengths (including a 10 percent contingency) and not total footage. It is also recommended that FCTC be required to fill the order with cable that has been quality controlled and with the ordered lengths unless no such cable exists in the inventory.

6 FINANCIAL.

a. Cost Estimating of Reimbursement Charges.

Poor estimating techniques and lack of comprehensive pricing information resulted in less accurate estimates than should have been provided to experimenters. Compounding the error was the fact that there was a lack of documenting correspondence to agencies formalizing costs and a lack of backup fact sheets in experiment files. There was also a lack of documenting correspondence that committed participating agencies to reimbursement in the following fiscal years.

To increase the accuracy of future estimates, the estimates should be based upon current, factual cost information. Analysis of costs on MILL RACE and DISTANT RUNNER should provide a good data base for cost estimates. It is recommended that a "HE Price Index and Cost Estimate Guide" be prepared and used by Program Analysts on future HE tests. It is also recommended that the Program Analyst ensure that there is a good correspondence audit trail for all funding transactions, both experimenter and support agency. This official correspondence must commit sponsors to fully reimburse FCDNA for their participation in an HE test.

b. Cable Costs.

The cable used on MILL RACE was supplied by the Test Construction Division (FCTC) but the cost was not provided. As a result there was much confusion about what costs to use, how credit for returned cable is determined, and in general, lack of knowledge on the costing of cables.

To assist in estimating reimbursable cable costs, FCTC should widely publish cable unit costs for each HE test by the first POM. After each delivery of cable to an HE test, FCTC should forward a bill along with the quantity and type of cable issued so that the Program Analyst can track the total cost of the event. To clarify cable costing procedures, there should be an expansion of the current FCDNA cable policy instruction to include an explanation of how credit is allowed on the return of cable, and what the standard policy is for experimenters using cable.

c. Fiscal Year Funding.

The last day to submit purchase orders under Blanket Purchase Agreements (BPAs) for MILL RACE was 11 September 1981, 5 days prior to shot day even though BPA requirements continued for weeks after the shot. Recommend that arrangements be made so that funding to cover BPAs is carried through the fiscal year into October.

7 INSTRUMENTATION TRAILERS.

a. Grounding and Shielding.

The method used to ground and shield instrumentation trailers for MILL RACE consisted of a single point ground for each trailer where all trailers were treated as shielded containers with signal cables entering the trailer through a conducting bulkhead. All 20-pair bundle shields were tied to the external trailer shell. Each instrumentation trailer was grounded by #2 copper wire to a 150-foot (45.7-meter) long ground rod. Exceptions to this method were the trailers used by S^3 and FEMA/SRII. S^3 grounded their experiment in the instrument pit, 500 feet (152 meters) from GZ, and at the trailer. The two shields were isolated by breaking the cable shields with the use of a transformer at the trailer. This method was used because of concern of ground loops generated by the fireball interaction and caused no problems. FEMA/SRII signal cables directly entered their trailer without being grounded at the trailer shell. This was an agency furnished trailer and was not equipped with a bulkhead cable intrusion panel nor was it feasible to install one. All cables entering the van were RG-213 coax carrying high level multiplex signals of approximately 10 volts. The noise was in the low mV range and was not considered a problem.

Ideally the grounding and shielding method that was used for the majority of the instrumentation trailers on MILL RACE should be used on all instrumentation trailers used on HE tests. The method proved to be adequate with no degradation due to electronic noise. As seen on MILL RACE there were exceptions to the grounding and shielding methods used but, at least in the case of MILL RACE, these exceptions posed no problems. Therefore no hard and fast decision should be made to ground and shield all instrumentation trailers in the same manner. Each agency fielding their own trailer vice a DNA owned trailer should have their shielding and grounding method evaluated by the TGS by the second POM to determine if the method will present any problem to the complete testbed.

b. Air Conditioning Maintenance.

On past tests air conditioning maintenance support was provided on an as-needed basis until the final two weeks before shot day when full time support became available. On MILL RACE, full time air conditioning maintenance support was started at D-90. At that time, power was available to the instrumentation parks, and trailers were starting to arrive. All air conditioning units were checked for proper operation as the trailers were received. This initial check was then followed by periodic checks and routine preventive maintenance. This was made cost effective by having the air conditioning maintenance man assist the cable coordinator and handle most power problems including initial trailer hook-up and maintenance on motor generator sets and isolation transformers. As there were no catastrophic failures, the routine preventive maintenance program and an air conditioning maintenance person on site by D-90 served its purpose and should be adopted for future HE tests.

8 EXPERIMENTS.

a. Add-on Experiments.

During the period when an add-on experiment was being considered for approval, confusion existed among the staff members as to what type of support should be provided for the pending experiment. Two recommendations are made. First it is recommended that an experiment submission cut-off date be established and well published. Second it is recommended that when add-on experiments are proposed, the TGD and TD (and the TGE if construction is necessary) should meet, make a decision as soon as possible and immediately make known their decision to all TGS members. The add-on experimenter then should be required to immediately provide all TGS members with his EDSs or TSP (if they are then in use).

b. Drones.

The drone experiment required the granting of a safety waiver by WSMR because of the close proximity of the two instrumentation parks to the flight path of the drones. If unmanned drones are approved to participate on a high explosive test, advanced planning of safety and testbed manning is required. Specifically the drone(s) operation may restrict manning on the testbed. This must be known early so that any restrictions can be worked around, e.g., on MILL RACE there was the possibility that the North Instrumentation Park would have to be remoted. This would not have been possible late in fielding. Recommend that drone flight plan be firmed up early in order to establish safety constraints.

9 DRY RUNS.

Participation by experimenters on mandatory dry runs was not enforced well enough and was less than satisfactory. Due to the concurrent fielding of DISTANT RUNNER, technical photography setup was not scheduled until D-14 thereby missing the full-power, full-frequency dry runs. This specific circumstance must be avoided on future tests. There was never 100 percent participation on the full-power full-frequency, mandatory full-power, or the final dry run. The mandatory dry runs are necessary not only for individual system checks but for system interaction between experiments and a checkout of the timing and firing system. These items must be functioning correctly at shot time to assure the successful execution of the test. The only way to ensure they are functioning correctly is for full participation in dry runs, correction of deficiencies discovered, and then participation in the next dry run. The TGD must insist on the participation of all experimenters on all mandatory dry runs. The fact that all experimenters must participate in mandatory dry runs must be widely promulgated. Allowing any experiment which had not satisfactorily participated in a dry run to remain on the test must be decided on a case-by-case basis.

10 PHOTOGRAPHY.

a. Still Photography.

Although there were complaints from experimenters that photography support was not adequate, few experimenters complied with the requirement to schedule a photographer. An analysis of photography support showed a photographer was available all of the time and was actually present on the testbed 82 percent of the normal work week. The method of having experimenters schedule a photographer as needed should be continued for future HE tests.

b. Receipt of Still Photography.

On MILL RACE the turnaround time from the time a picture was taken until receipt of the print was approximately 2.5 weeks. This time included placing a caption on each print and returning it more than 100 miles (160.9 km) for delivery. Until about a week before shot day, about two dozen photos were taken each day with the captions generally correct but the 2.5 weeks turnaround was too long. One week prior to and including shot day, a much larger number of pictures were taken. This much larger number grossly increased the caption error to the point that many more photos were incorrectly identified than were correctly identified. Although the turnaround time for shot day photos was reduced, the time was still considered to be excessive.

For the next HE test, FCDNA must negotiate with WSMR to establish a method to decrease the turnaround time for delivery of pictures and to greatly increase the percent of pictures that are captioned correctly. A sense of urgency must be impressed on WSMR so that shot day pictures are correctly captioned and returned within 48 hours. A recommended solution for the caption problem is to "hire" a WSMR photographer to coordinate and process (develop, caption, and deliver) all pictures during shot week.

c. Timing and Firing Photo Support.

Due to concurrent fielding of DISTANT RUNNER, installation of both technical and diagnostic photo equipment did not commence until approximately two weeks prior to shot. Even though all preliminary wiring had been completed by timing and firing personnel, the actual hookup and checkout cameras accounted for approximately 80 percent of the T&F personnel's normal work day and 100 percent of their overtime during these last two weeks. Not only was the checkout time for the technical and diagnostic photo system inadequate, as indicated by postshot analysis, but insufficient time was allowed for complete T&F system checkout and fine tuning. As a minimum, camera installation on future HE tests must start by D-30 to ensure sufficient time for checkout and participation on mandatory dry runs.

d. Additional Prints.

The negatives for all still pictures were maintained by WSMR who reproduced prints as requests were received from experimenters, FCDNA personnel, and others. All requests for additional pictures were sent to and forwarded by the TGS photo coordinator. A large number of requests, a backlog of prints to make, and the distance between WSMR and FCDNA all contributed to an unacceptable time from request for prints to delivery.

It is recommended that on future HE tests each experimenter be provided with a color negative and a color print of each photo he has requested, in addition, a copy of each negative and each print should be delivered to the TGS photo coordinator. This would provide the experimenter with flexibility in obtaining additional prints and reduce the excessive handling of numerous negatives by WSMR photo personnel.

e. Internal Technical Cameras.

The camera and light stands used for the interior photography of the vehicles exposed on MILL RACE were initially not compatible with the vehicles. There was inadequate time to make the proper modifications. There was a lack of coordination between the experimenter, FCDNA, and WSMR in getting necessary information. WSMR did not go out of their way to get the information either. If the experimenter cannot describe the test objective (for camera design) early enough, then negotiations should be held with WSMR to task experimenters to do their own interior photography. When the vehicle arrives on the testbed, all photography items must be installed and all that would be necessary is to hook up the cameras to the T&F cables.

f. Camera Boxes.

Camera boxes located in the area above the 30 psi (206.8 kPa) level were deformed by the airblast resulting in jamming of cameras located in the boxes. A redesign of camera boxes located in regions greater than the 30 psi (206.8 kPa) level must be accomplished prior to the next HE test.

11 OBSERVATION POINT.

MILL RACE Staff Observation Point (OP) coordinator and the WSMR public affairs officer (PAO) established the routine to be followed at the OP and on the GZ tour on shot day. It was a well coordinated, well thought out plan. Unfortunately a few days before shot day too many additional people (HQ DNA, PAO, and FCDNA Staff) started to make numerous changes to the plan and confusion resulted. The TGD must develop an OP plan, get endorsement (in writing) of the plan and then try to restrict others from making any changes. A separate radio net must be set up between the OP and Test Control to keep OP traffic off the test countdown net.

12 MISCELLANEOUS.

a. Fuel.

The decision to have controlled petroleum products (gas and oil) located in the close vicinity of the Administrative Park was a great saver of time. The same arrangements should be made on future HE tests.

b. Government Quarters.

Renting motel rooms seven days a week for a projected fielding period was not cost effective because of the low utilization rate. It is highly recommended that the TGS be housed at the same location; however, a more flexible contract arrangement should be negotiated which allows short notice changes to occupancy dates and billing for only the days used. Consideration should also be given to renting apartments as they are normally cheaper.

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